US Army Corps
of Engineers
GREAT LAKES AND OHIO RIVER DIVISION

LOUISVILLE District / HUNTINGTON District / PITTSBURGH district

Ohio River Main Stem Systems Study (ORMSS)

# Integrated Decision Document and Environmental Assessment:

# Ohio River Ecosystem Restoration Program

## Appendix H:

## EXAMPLE ECOSYSTEM RESTORATION PROJECTS

Restore and Protect the Ohio River Ecosystem

**FINAL** **October 2000**

**DEPARTMENT OF THE ARMY**
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE, KENTUCKY 40201-0059

# Integrated Decision Document and Environmental Assessment :

# Ohio River Ecosystem Restoration Program

**ILLINOIS, INDIANA, KENTUCKY, OHIO, WEST VIRGINIA, PENNSYLVANIA**

## Appendix H:

# EXAMPLE ECOSYSTEM RESTORATION PROJECTS

**October 2000**

# APPENDIX H

## H.1. Summary of Tasks Completed on Example Ecosystem Restoration Projects

Five example ecosystem restoration projects are presented in this appendix to illustrate some of the types of projects that may be implemented if a Ecosystem Restoration Program is authorized for the Ohio River. Each example has a description of existing conditions at the study site, project description, alternatives to the proposed project, engineering design requirements, costs, benefits, and potential environmental impacts.

Following above descriptions an incremental analysis of project alternatives is provided.

## H.2. Tasks to be Completed on Example Projects in Future

## in Project Implementation Phase

The information provided with the example projects is not sufficient for specific project authorization. Additional investigations would be required before a project could be approved under the proposed ecosystem restoration program. Additional feasibility level studies, would include cultural investigations, additional environmental studies and coordination of the specific project with the nonfederal sponsor, various agencies and the public.

### H.2.1 Environmental Compliance

To assure that each project meets all the requirements of the law, various statutes and Executive Orders, further investigation would still be required along with obtaining necessary permits and certifications. See Exhibit H-1 for a list of Federal laws and policies that will be checked to assure proper compliance.

# Appendix H:

## EXAMPLE ECOSYSTEM RESTORATION PROJECTS

# Table of Contents

**Item** **Page**

Exhibit G- 6 Federal Laws and Policies Applicable to all Recommended Plans

| TITLE OF PUBLIC LAW | US CODE |
|---|---|
| | |
| Abandoned Shipwreck Act of 1987 | 43 USC 2101 |
| American Indian Religious Freedom Act | 42 USC 1996 |
| Agriculture and Food Act (Farmland Protection Policy act) of 1981 | 7 USC 4201 et seq |
| American Folklife Preservation Act of 1976, As Amended | 20 USC 2101 |
| Anadromous Fish Conservation Act of 1965, As Amended | 16 USC 757a et seq |
| Antiquities Act of 1906, As Amended | 16 USC 431 |
| Archeological and Historic Preservation Act of 1974, As Amended | 16 USC 469 |
| Archaeological Resources Protection Act of 1979, As Amended | 16 USC 470 |
| Bald Eagle Act of 1972 | 16 USC 668 |
| Buy American Act | 41 USC 102 |
| Civil Rights Act of 1964 (Public Law 88-352) | 6 USC 601 |
| Clean Air Act of 1972, As Amended | 42 USC 7401 et seq |
| Clean Water Act of 1972, As Amended | 33 USC 1251 et seq Coastal |
| Barrier Resources Act of 1982 | 16 USC 3501-3510 |
| Coastal Zone Management Act of 1972, As Amended | 16 USC 1451 et seq |
| Comprehensive Environmental Response, Compensation and Liability Act of 1980 | 42 USC 9601 |
| Conservation of Forest Lands Act of 1960 | 16 USC 580 mn |
| Contract Work Hours | 40 USC 327 |
| Convict Labor | 18 USC 4082 |
| Copeland Anti-Kickback | 40 USC 276c |
| Davis Bacon Act | 40 USC 276 |
| Deepwater Port Act of 1974, As Amended | 33 USC 1501 |
| Emergency Flood Control Funds Act of 1955, As Amended | 33 USC 701m |
| Emergency Wetlands Resources act | 16 USC 3901-3932 |
| Endangered Species Act of 1973 | 16 USC 1531 |
| Estuary Protection Act of 1968 | 16 USC 1221 et seq |
| Equal Opportunity | 42 USC 2000d |
| Farmland Protection Policy Act | 7 USC 4201 et seq |
| Federal Environmental Pesticide Act of 1972 | 7 USC 136 et seq |
| Federal Water Project Recreation Act of 1965, As Amended | 16 USC 4601 |
| Fish and Wildlife Coordination Act of 1958, As Amended | 16 USC 661 |
| Flood Control Act of 1944, As Amended, Section 4 | 16 USC 460b |
| Food Security Act of 1985 (Swampbuster) | 16 USC 3811 et seq |
| Hazardous Substance Response Revenue Act of 1980, As Amended | 26 USC 4611 |



**Exhibit H-1**

| | |
|---|---|
| *Historic and Archeological Data-Preservation* | *16 USC 469* |
| *Historic Sites Act of 1935* | *16 USC 461* |
| *Jones Act* | *46 USC 292* |
| *Land and Water Conservation Fund Act of 1965* | *16 USC 4601* |
| *Magnuson Fishery Conservation and Management Act* | *16 USC 1801* |
| *Marine Mammal Protection Act of 1972, As Amended* | *16 USC 1361* |
| *Marine Protection, Research, and Sanctuaries Act of 1972* | *33 USC 1401* |
| *Migratory Bird Conservation Act of 1928, As Amended* | *16 USC 715* |
| *Migratory Bird Treaty Act of 1918, As Amended* | *16 USC 703* |
| *National Environmental Policy Act of 1969, As Amended* | *42 USC 4321 et seq* |
| *National Historic Preservation Act of 1966, As Amended* | *16 USC 470* |
| *National Historic Preservation Act Amendments of 1980* | *16 USC 469a* |
| *Native American Religious Freedom Act of 1978* | *42 USC 1996* |
| *Native American Graves Protection and Repatriation Act* | *25 USC 3001* |
| *Native American Religious Freedom Act of 1978* | *16 USC 469a* |
| *National Trails System Act* | *16 USC 1241* |
| *Noise Control Act of 1972, As Amended* | *42 USC 4901 et seq* |
| *Rehabilitation Act (1973)* | *29 USC 794* |
| *Reservoir Salvage Act of 1960, As Amended* | *16 USC 469* |
| *Resource Conservation and Recovery Act of 1976* | *42 USC 6901-6987* |
| *River and Harbor Act of 1888, Sect 11* | *33 USC 608* |
| *River and Harbor Act of 1899, Sections 9, 10, 13* | *33 USC 401-413* |
| *River and Harbor and Flood Control Act of 1962, Section 207* | *16 USC 460* |
| *River and Harbor and Flood Control Act of 1970, Sections 122, 209, and 216* | *33 USC 426 et seq* |
| *Safe Drinking Water Act of 1974, As Amended* | *42 USC 300f* |
| *Shipping Act* | *46 USC 883* |
| *Submerged Lands Act of 1953* | *43 USC 1301 et seq* |
| *Superfund Amendments and Reauthorization Act of 1986* | *42 USC 9601* |
| *Surface Mining Control and Reclamation Act of 1977* | *30 USC 1201-1328* |
| *Toxic Substances Control Act of 1976* | *15 USC 2601* |
| *Policy Act of 1970, As Amended* | *43 USC 4601* |
| *Utilization of Small Business* | *15 USC 631, 644* |



**Exhibit H-1**

| | |
|---|---|
| *Vietnam Veterans* | *38 USC 2012* |
| *Water Resources Development Act of 1974, As Amended* | *88 Stat 12* |
| *Water Resources Development Act of 1976, Section 150* | *90 Stat 2917* |
| *Water Resources Development Act of 1986* | *33 USC 2201 et seq* |
| *Water Resources Development Act of 1988* | *33 USC 2201 note* |
| *Water Resources Development Act of 1990* | *33 USC 2201 note* |
| *Water Resources Development Act of 1992* | *33 USC 2201 note* |
| *Water Resources Development Act of 1996* | *33 USC 2201 note* |
| *Watershed Protection and Flood Control Act of 1954, As Amended* | *16 USC 1001 et seq* |
| *Wild and Scenic Rivers Act of 1968, As Amended* | *16 USC 1271 et seq* |
| *Wilderness Act* | *16 USC 1131* |
| *Walsh-Healy* | *41 USC 35 et seq* |
| ***EXECUTIVE ORDERS*** | |
| *11593, Protection and Enhancement of the Cultural Environment. May 13, 1979* | *36 FR 8921; May 15, 1971* |
| *11988 Floodplain Management. May 24, 1977* | *42 FR 26951; May 25, 1977* |
| *11990, Protection of Wetlands. May 24, 1977* | *42 FR 26961; May 25, 1977* |
| *11514, Protection and Enhancement of Environmental Quality, March 5, 1970, as amended by Executive Order, 11991, May 24, 1977* | |
| *12088, Federal Compliance with Pollution Control Standards, October 13, 1978* | |
| *12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations, February 11, 1994* | |
| ***OTHER FEDERAL POLICIES*** | |
| | |
| *Council on Environmental Quality Memorandum of August 11, 1980: Analysis of Impacts on Prime and Unique Agricultural Lands in Implementing the National Environmental Policy Act.* | |
| | |
| *Council on Environmental Quality Memorandum of August 10, 1980: Interagency Consultation to Avoid or Mitigate Adverse Effects on Rivers in the Nationwide Inventory.* | |
| | |
| *Migratory Bird Treaties and other international agreements listed in the Endangered Species Act of 1973, as amended, Section 2(a)(4).* | |



**Exhibit H-1**

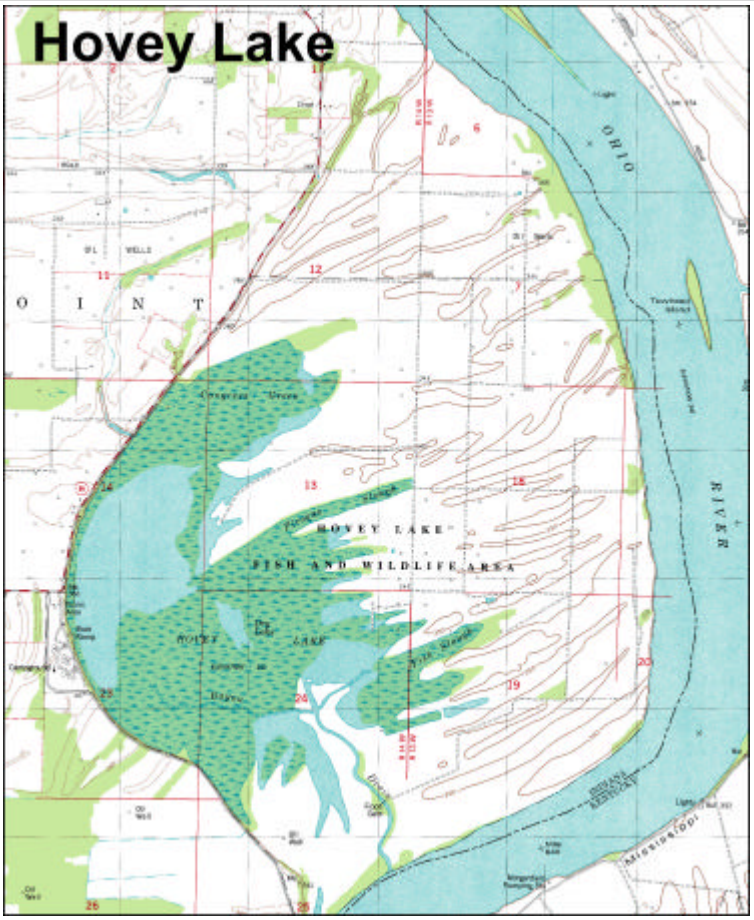
## Exhibit H-2. EXAMPLE 1. HOVEY LAKE RESTORATION, INDIANA

3.1 Description of Project and Impacts
3.2 Incremental Analysis

# EXHIBIT H-2
# 3.1 Hovey Lake Restoration & Hovey Lake Habitat Restoration (IN-10/11)

## 1.0 Location

The proposed Hovey Lake Restoration Project area is located at the State of Indiana's Hovey Lake Fish and Wildlife Management Area (FWA). The Indiana Department of Natural Resources (IDNR) manages Hovey Lake FWA. The Hovey Lake FWA encompasses an area that includes lands owned by the U.S. Federal Government as well as the State of Indiana. The proposed Hovey Lake Restoration Project includes restoration efforts on the FWA proper as well as on adjoining private lands.




The Hovey Lake project area is located in rural Posey County, Indiana approximately 7 miles south of the town of Mt. Vernon, Indiana. The project site is located in the J. T. Myers Pool near Ohio River Miles (ORM) 835-841. Hovey Lake is within the jurisdiction of the Louisville District, U.S. Army Corps of Engineers (USACE).

## 2.0 Project Goal

Hovey Lake is one of a few large Ohio River oxbow lakes remaining in the State of Indiana. Oxbow lakes, which are cut-off from the river except during periods of high river stage, are important spawning, nursery and feeding areas for riverine fishes. Oxbow lakes also provide important habitat for migratory waterfowl, wading birds and other wildlife.

Oxbow lakes, due to their cut-off nature and location within river floodplains, historically slowly fill in with sediments. Prior to establishment of commercial navigation and the construction of dams, the creation and loss of oxbow lakes was a

natural event. New oxbows were formed whereas older oxbows gradually filled in with sediment and became terrestrial habitat, consequently oxbow habitats were typically always present within the river system. With the establishment of the navigation system on the Ohio River the natural process of oxbow lake formation has ceased. New Ohio River oxbow lakes are no longer being formed. Consequently, the remaining oxbow lakes have become unique habitats that the State of Indiana wishes to protect and restore as functioning aquatic ecosystems.

## 3.0 Project Description and Rationale

The specific goals of the Hovey Lake restoration project include two distinct elements designed to prolong the functional life of the aquatic ecosystem at Hovey Lake and to improve the fish and wildlife habitat within the project area. The principal elements of the Hovey Lake Restoration Project are:

1. **Restoration of Oxbow Habitat.** The backwater habitat within the Hovey Lake oxbow serves as reproductive, feeding, nursery, high water refuge, seasonal migration and overwintering habitat for may fish species including paddlefish. Maximum depth of the lake has decreased by at least 3 feet since 1976 when the J. T. Myers Locks and Dam were completed. The aquatic habitat at Hovey Lake would be restored by dredging 50% of the 300-acre open basin to an average depth of 20 feet at normal pool.

2. **Erosion/Sediment Control and Ohio River Bank Stabilization.** Hovey Lake receives sediment deposition during Ohio River flood events. When the Ohio River leaves its banks, it floods across the private agricultural land north of Hovey Lake and into Hovey Lake. The flood waters carry sediments from: a) floodplain scour in the farmed areas north of the lake, b) river borne sediments and c) heavy bank erosion along the Ohio River banks north of the lake. The flood induced sedimentation appears to have increased since 1995 after erosion control structures were installed on Slim Island and the logging of trees occurred on the land north of the lake. These events appear to have changed the direction of the flood current and increased sediment loading in Hovey Lake. Restoration activities to address this problem will include:

    **2a. Shoreline Stabilization.** The Ohio River shoreline north of the lake is unstable and exhibits heavy bank erosion. This shoreline will be stabilized and bank erosion minimized by installing “A-jacks” structures. These structures will stabilize the banks and allow for natural re-vegetation and subsequent erosion control to occur.

    **2b. Reforestation.** Sedimentation reduction in Hovey Lake will be augmented via flood damage reduction. Reforestation of a large parcel near the Ohio River north of the lake will reduce erosion and slow flood waters allowing the sediment load to be dropped north of Hovey Lake rather than in Hovey Lake.

The completion of these elements will reduce the loss of oxbow habitat and restore the aquatic ecosystem of Hovey Lake. Habitat restoration will also be augmented via Indiana Department of Natural Resources management efforts, which may include:

1. Working with adjacent landowners to implement a series of Best Management Practices to reduce erosion of farmland.
2. Planting a series of forested/vegetated buffers between cropped fields to reduce lake sedimentation and reduce floodwater velocity.
3. Use of some dredge material to create swamp rabbit refuge at Hovey Lake FWA.

## 4.0 Existing Conditions

**Terrestrial/Riparian Habitat:** The habitat at the Hovey Lake project site consists of Hovey Lake with it's bald cypress (*Taxodium distichum*) community in and adjacent to the lake as well as the surrounding area comprised of agricultural land and bottomland/riparian forested areas. Hovey Lake FWA is primarily managed for waterfowl, however a wide variety of game and nongame species occur in the area including white-tailed deer, turkey, great blue heron, and river otter.

**Hovey Lake Bald Cypress**

**Agriculture at Hovey Lake**

The habitat within the project area north of Hovey Lake FWA is privately owned and is principally agricultural in nature. Along the banks of the Ohio River scattered trees are present. Throughout most of the project area the river banks exhibit heavy bank erosion.

**Eroding River Bank**

**Flood Scoured Field**

**Aquatic Habitats:** Hovey Lake aquatic habitat is dominated by shallow water areas (approximately 1 to 5 feet deep) that support stands of bald cypress. The lake also contains a 300 acre deep water basin with water approximately 6 to 10 feet deep under normal pool conditions. The lake supports a diverse fishery including orangespotted sunfish, yellow bass, bluegill, white crappie, channel catfish, and other species. The lake is also known to hold large numbers of paddlefish (Hovey Lake Fish Survey, 1996).

**Wetlands:** Wetlands within the Hovey Lake project area are primarily limited to the riparian areas adjacent to the lake.

**Federally-Listed Threatened and Endangered Species** According to the U.S. Fish and Wildlife Service (USFWS), there are 7 federally-listed threatened or endangered species known to occur in Posey County, Indiana (Table 1).

**Table 1. Federally-listed species known to occur in Posey County, Indiana.**

| Common Name | Scientific Name | Federal Status | Habitat Present |
|---|---|---|---|
| Indiana bat | *Myotis sodalis* | Endangered | Yes |
| Bald eagle | *Haliaeetus leucocephalus* | Threatened | Yes |
| Tubercled blossom mussel | *Epioblasma torulosa* | Endangered | River |
| Pink mucket pearly mussel | *Lampsilis abrupta* | Endangered | River |
| Ring pink mussel | *Obovaria retusa* | Endangered | River |
| Rough pigtoe mussel | *Pleurobema plenum* | Endangered | River |
| Fat pocketbook mussel | *Potamilus capax* | Endangered | River |

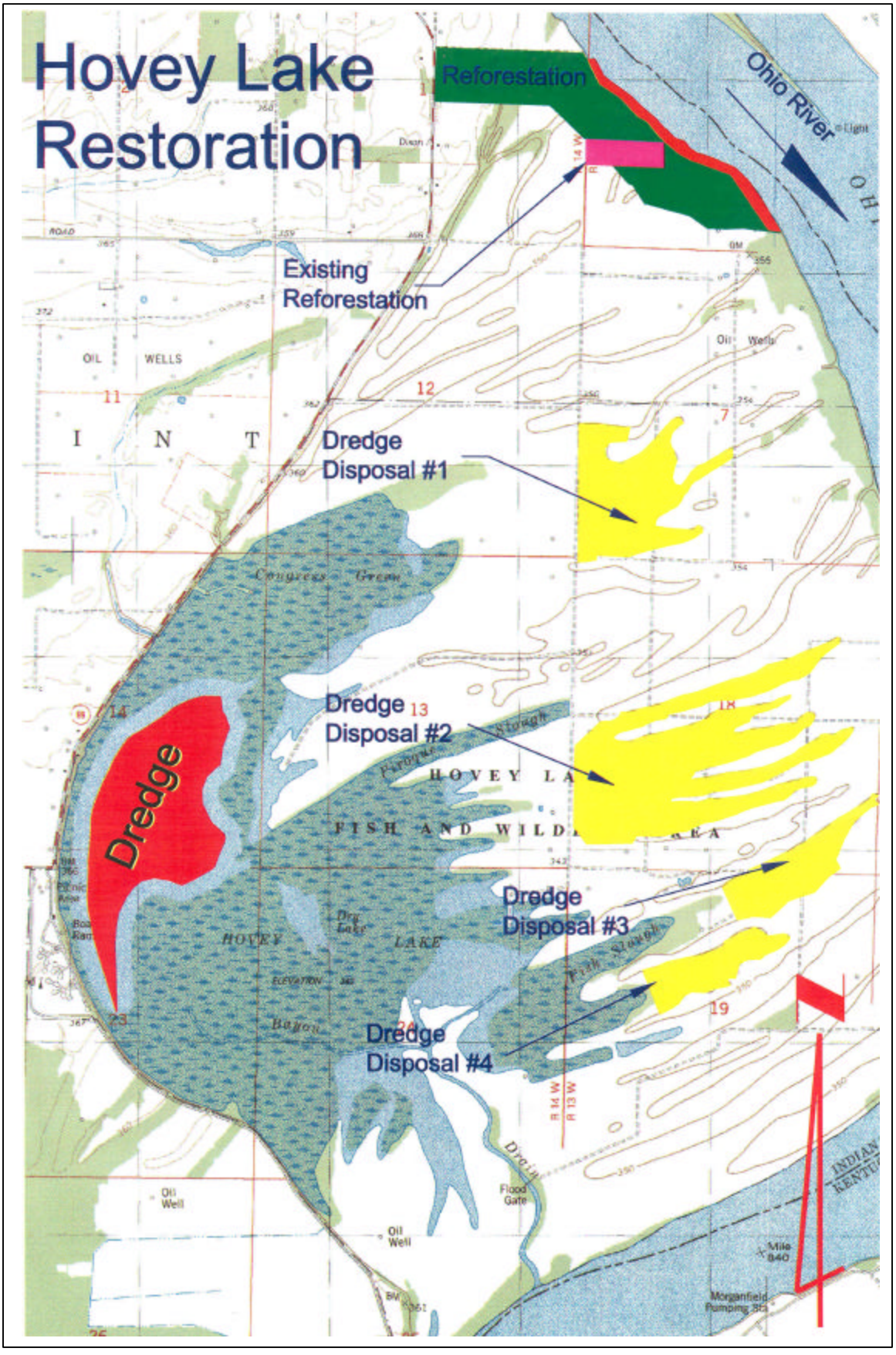
*Source: U.S. Fish and Wildlife Service, 1999*

The Indiana bat is known to occur in the project area at Hovey Lake FWA. The riparian area provides summer roosting and foraging habitat for this species.

Bald eagles over winter at Hovey Lake. Hovey Lake is also known to provide habitat for successful nesting bald eagles.

The five endangered mussel species known from Posey County would not be found in Hovey Lake. These species are more typically associated with the riverine habitats in the Ohio and Wabash Rivers.

## 5.0 Project Diagram



## 6.0 Engineering Design, Assumptions, and Requirements

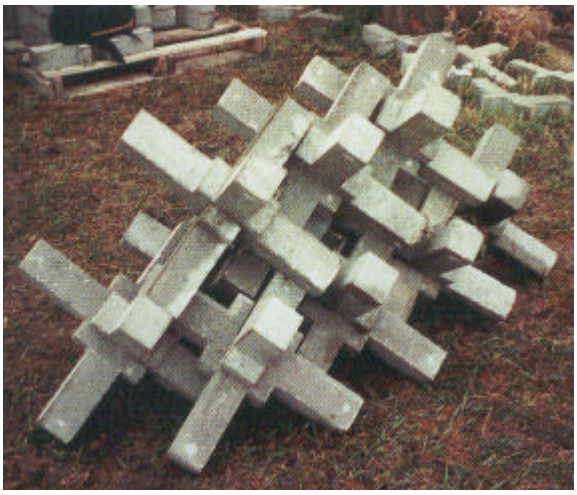
### 6.1 Existing Ecological/Engineering Concern

Hovey Lake is one of a few large Ohio River oxbow lakes remaining in the State of Indiana. Hovey Lake is slowly filling in with sediments. The State of Indiana wishes to protect and restore this unique aquatic ecosystem.

### 6.2 Hovey Lake Dredging

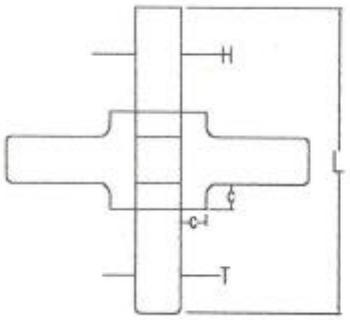
Maintenance dredging of Hovey Lake is required to provide deep water habitat, and to extend the life of the historic oxbow. An estimated 2,490,000 cubic yards of silty-clay material would be dredged to restore depths of 7-20 feet. The outer limits of dredging would occur approximately 100 yards inside of the open basin area of Hovey Lake (approximately 145-acres of the 300-acre open basin will be dredged). Depths at this distance currently range from 6-7 feet. Dredging would begin at this location and would descend at a 10:1 slope to depths of 20 feet. Four dredge disposal sites are adjacent to the lake. Small geotube levees, 5 feet high would be constructed at the designated disposal sites for dewatering. All disposal areas are located on property owned by the State of Indiana. The disposal areas will be graded to a near even height and reseeded with native species following the dewatering process.

### 6.3 Shoreline Stabilization



**A-jacks Structures**

River currents in conjunction with barge traffic are actively eroding the Ohio River bank. The erosion has produced steep banks with little or no vegetation and a biostabilization approach to bank protection is preferred to simple bank hardening (rip-rap). A-jacks® by Armortec, or similar structures, will be used as structural bank reinforcement at the underwater base of the eroding bank combined with revegetation of the upper slope (approximately 0.9 miles of shoreline will be stabilized). A-jacks® are assembled into a highly porous, interlocking matrix. The voids created by the interlocking A-jacks®, or similar structures, are filled with soil to establish a foundation to support woody vegetation above the normal pool elevation of the Ohio River. A geotextile fabric would be used in conjunction with an aggregate base to reduce the removal of fine soils while the root systems are developing. Light mast producing trees such as black willow, cottonwood, and sycamore will be allowed to reseed/regenerate naturally in the structure voids. If necessary, additional cuttings and rooted stock can be placed in and behind the A-jacksσ matrix along the earthen berm to augment natural revegetation.




| A-Jacks | L(in) | T(in)/H(in) | C(in) | Vol($ft^3$) | Wt(lbs) |
|---|---|---|---|---|---|
| AJ-24 | 24 | 3.68 | 1.84 | 0.56 | 78 |
| AJ-36 | 36 | 5.52 | 2.76 | 1.89 | 265 |
| AJ-48 | 48 | 7.36 | 3.68 | 4.49 | 629 |
| AJ-72 | 72 | 11.04 | 5.52 | 15.14 | 2,120 |
| AJ-96 | 96 | 14.72 | 7.36 | 35.87 | 5,022 |

**A-jacks® Dimensions**

**A-jacks® Bank Stabilization**

### 6.4 Reforestation

Approximately 120 acres of floodplain will be reforested with native mast producing bottomland hardwood trees. The forested area will aid in the reduction of drift, trash, and sediments from Ohio River floodwaters into Hovey Lake. Historically, these sediment and trash laden floodwaters have accelerated the filling of Hovey Lake. The reforestation will aid in flood desynchronization and prolong the life and viability of the Hovey Lake ecosystem.

Soil types, hydrology, and terrain position will be the primary factors considered when selecting the tree species to be planted, and a detailed planting design should be developed in order to insure that the planting effort is successful. Typical bottomland species to be planted in the floodplain area would include pin oak (*Quercus palustris*), swamp chestnut oak (*Quercus michauxii*), swamp white oak (*Quercus bicolor*), pecan (*Carya illinoensis*), and shagbark hickory (*Carya ovata*). Aggressive light mast producing species, such as silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), sycamore (*Platanus occidentalis*), and/or willows (*Salix* spp), would be expected to regenerate naturally.

### 6.5 Planning/Engineering Assumptions

**Dredging**

- Three small auger head dredges would be used, and the material would be pumped directly to the disposal sites. All dredges would be utilized in three shifts.
- All dredge disposal sites were selected from USGS topographic maps, and site visits. Detailed survey data would be required to better determine the limits, and volumes of the disposal areas.

**Bank Stabilization**

- Average channel velocities are 3 feet per second.
- Armortec's A-jacks® AJ-24 units would be used to stabilize the toe of the eroding slope. Each unit weighs 78 pounds and is small enough to be assembled and placed by hand.
- Two rows of A-jacks® would be toed into the river bed a minimum of 1.5 feet deep.
- A-jacksσ would be interconnected in rows along the toe trench. Two rows would be used at the base, with a single row on top.
- Backfill sediment for the voids would be taken from onsite.

**Reforestation**

- Nursery stock for reforestation will be obtained from a State of Indiana nursery.
- Bare root seedlings will be planted in a similar manner to ongoing reforestation efforts being conduction in the Hovey Lake area.

## 7.0 Cost Estimate (Construction)

**Dredging -** Engineering costs for the proposed project are contained on Table 2. A detailed MCACES cost estimate for the proposed project is included in Appendix D.

**Table 2. Engineering Costs.**

| **Item – Hovey Lake Restoration** | **Cost** |
|---|---|
| Dredging | $2,346,000 |
| Geotube Levee | $79,300 |
| A-Jacks Bank Stabilization | $241,100 |
| Reforestation | $31,700 |
| Mobilization and Contingencies @ 20% | $269,800 |
| **TOTAL** | **$2,750,900** |

## 8.0 Schedule

**Hovey Lake Restoration:** The estimated construction time is shown on Table 3.

| **Table 3. Construction Schedule.** | |
|---|---|
| **Item – Hovey Lake Restoration** | **Cost** |
| Dredging | 307 Days |
| Levee | 42 Days |
| Dewatering | 168 Days |
| A-Jacks Bank Stabilization | 60 Days |
| Reforestation | 15 Days |
| Mobilization | 12 Days |
| **TOTAL** | **604 Days** |

## 9.0 Expected Ecological Benefits

**Terrestrial/Riparian Habitat:** The Hovey Lake Restoration project would result in long-term beneficial impacts to terrestrial/riparian resources. The reforestation of 120 acres adjacent to the Ohio River would be considered a long-term beneficial impact to terrestrial/riparian resources. Although the reforestation is primarily designed to aid in flood desynchronization, the reforestation would be beneficial to many game and nongame species of wildlife. The conversion of agricultural lands to upland and bottomland forest, would result in sustained long-term beneficial impacts to terrestrial resources.
The dredging activities proposed for Hovey Lake would be within the open basin of the lake. There would be no reasonably foreseeable beneficial impacts to terrestrial/riparian resources associated with the dredging activities.

**Aquatic Habitats:** Long-term beneficial impacts to aquatic resources would be anticipated as a result of implementing the proposed project. Dredging of the open basin at Hovey Lake would result in long-term beneficial impacts to fishes due to the improved/deepened waters in the oxbow. Habitat requirements for fishes change seasonally and improved depth in the oxbow would be considered beneficial. Restoring/increasing the depths of the oxbow would provide over-wintering habitat for fishes, especially fish such as paddlefish. The project would result in an overall improvement in off channel aquatic habitat in the area and an increase in the functional life of the Hovey Lake aquatic ecosystem.

Long-term beneficial impacts to aquatic resources would also be anticipated as a result of the proposed reforestation and bank stabilization. The reforestation along the river bank would reduce potential stream bank erosion. The conversion of agricultural land to forest would indirectly improve water quality by reducing the amount of silt and contaminants from entering the Ohio River via stormwater runoff.

**Wetlands:** There would be long-term beneficial impacts to jurisdictional wetlands as a result of implementing the proposed project. Reforestation would provide buffers for riparian zones and bottomland hardwoods in the vicinity of Hovey Lake.

**Federally-Listed Threatened and Endangered Species**: There would be minor beneficial impacts to the Indiana bat and bald eagle associated with the planned reforestation. The project will result in a net increase in forested riparian habitat within the study area that can be utilized by these species.

Other than indirect benefits associated with improved water quality, there would be no reasonably foreseeable beneficial impacts to the endangered mussel species in the Ohio River near the project site as a result of implementing the proposed project.

**Socioeconomic Resources:** There would be short-term and long-term beneficial impacts to socioeconomic resources as a result of implementing the proposed project. The short-term beneficial impacts would be related to costs and local expenditures associated with the dredging of Hovey Lake and the bank stabilization and reforestation of the Ohio River shoreline.

### 10.0 Potential Adverse Environmental Impacts

**Terrestrial/Riparian Habitat:** There would be short-term adverse impacts to the agricultural lands adjacent to Hovey Lake. Short-term impacts would occur associated with the disposal of the dredge material on the adjacent agricultural lands. Adverse impacts to this area would be considered short term, because it is assumed that the site can be farmed following the dewatering and grading of the dredge material. These agricultural fields are primarily used by Hovey Lake FWA as part of their on-going waterfowl management program.

**Aquatic Habitats:** There would be a potential for minor adverse affects to aquatic species in the lake and in the river. In Hovey Lake adverse impacts may occur to immobile benthic invertebrates during the dredging operations. Localized populations of benthic invertebrates could be directly disturbed during the construction operation. However, the invertebrate populations within the open water basin of the lake where the dredging is proposed are not expected to be as abundant, diverse, or important to the ecosystem as the invertebrates colonizing the shallow water bald cypress portions of Hovey Lake.

The dredging operations in Hovey Lake may also have a short-term adverse impact on the fish population by directly disturbing their habitat and increasing turbidity. However, with the exception of open water species such as paddlefish, the open water basin of the lake, where the dredging will occur, is not expected to contain the number and diversity of fishes that are supported within the shallow water bald cypress portions of Hovey Lake.

Adverse impacts to aquatic species in the Ohio River will be short-term and minor. During the bank stabilization phase of the proposed project, sensitive aquatic species immediately downstream from the site could be adversely impacted by degraded water quality associated with displaced bank sediments.

It is assumed that Hovey Lake, with its current average depth of approximately six to eight feet, stratifies during the summer, and anoxic zones are created. Following the dredging/deepening of Hovey Lake, there would continue to be a potential for summer stratification, and subsequent anoxic zones may become established in deep water areas. It is unlikely that the stratification of Hovey Lake would cause meaningful additional adverse affects to aquatic resources.

**Wetlands:** There would be no adverse effects to jurisdictional wetlands as a result of implementing the proposed plan.

**Federally-Listed Threatened and Endangered Species:** There would be no reasonably foreseeable adverse impacts to most federally listed threatened and endangered species as a result of implementing the Hovey Lake Restoration project. There is the potential for the dredging operations to disturb bald eagles at Hovey Lake. The dredging operations will be limited to the open basin of the lake and will not influence the other portions of the Hovey Lake FWA, consequently these impacts are expected to be short-term and minor.

**Socioeconomic Resources:** There would be long-term and short-term adverse impacts to socioeconomic resources as a result of implementing the Hovey Lake Restoration Project. The long-term impacts will be associated with the permanent loss of approximately 120 acres of terrestrial floodplain agricultural lands that will be reforested. There would be short-term adverse impacts associated with the temporary loss of farming on approximately 320 acres of land comprising the dredge material disposal sites. These impacts would be short term because it is assumed that the disposal area can be farmed following the completion of the dredge material dewatering.

## 11.0 Mitigation

Minor impacts associated with site dredging and material placement may occur during the construction of this project, however, no significant adverse impacts are expected. The use of best management practices and proper construction techniques would minimize adverse water quality impacts.

Following the completion of the dredging and spoil dewatering operation, the dredge disposal site will be graded and restored for agricultural / wildlife management purposes.

## 12.0 Preliminary Operation and Maintenance Costs:

Operation and Maintenance costs are summarized on Table 4.

**Table 4. Operation and Maintenance Costs(50 Year Project Life)**

| Maintenance | Frequency | Costs |
|---|---|---|
| Hovey Lake | 25 Years | $500,000 |
| Bank Stabilization | 10 Years | $120,600 |

## 13.0 Potential Cost Share Sponsor(s)

- Indiana Department of Natural Resources
- Ducks Unlimited

## 14.0 Expected Life of the Project

The expected life of the project is 50 years.

## 15.0 Hazardous, Toxic, and Radiological Waste Considerations

Potential impacts of hazardous, toxic, and radiological waste (HTRW) at the site were visually assessed during a site visit and further assessed via a database search of HTRW records in the site area.

**Site Inspection Findings.** The project site consist Hovey Lake and a land area surrounding the lake which is located in Posey County Indiana at Ohio River mile 835-840. Hovey Lake is an oxbow lake formed by a meander cutoff of the Ohio River. Uniontown, KY is the nearest town to the project area and is located south across the Ohio River from Hovey Lake.

The following environmental conditions were considered when conducting the project area inspection on June 29, 1999:

- Suspicious/Unusual Odors;
- Discolored Soil;
- Distressed Vegetation;
- Dirt/Debris Mounds;
- Ground Depressions;
- Oil Staining;

- Above Ground Storage Tanks (ASTs);
- Underground Storage Tanks (USTs);
- Landfills/Wastepiles;
- Impoundments/Lagoons;
- Drum/Container Storage;
- Electrical Transformers;
- Standpipes/Vent pipes;
- Surface Water Discharges;
- Power or Pipelines;
- Mining/Logging; and
- Other

Inactive oil wells were observed in the project area. None of the other environmental conditions listed above were observed in the project area.

**Risk Management Data Search.** A search of available environmental records was conducted by Environmental Data Resources, Inc. (EDR). The search complied with ASTM Standard Practice for Environmental Site Assessments, E 1527-97. The search report with an enlarged map showing the search area around the project site is presented in Appendix B. The search distance was configured to include the area of the project and a one-mile buffer zone beyond the project area boundary. It was conservatively assumed that any environmental conditions beyond the project area buffer zone would not impact the project. The database search consisted of a landmass covering the entire Hovey Lake peninsula to include a one mile buffer beyond the outer limits of the project area boundary (see map in Appendix B). The HTRW item searched (e.g., USTs, NPL sites, etc.) and area searched are as follows:

| Databases | Search Area |
|---|---|
| **NPL:** National Priority List | Entire Hovey Lake Peninsula and a 1.0 mile buffer beyond the project boundary. |
| **RCRIS-TSD:** Resource Conservation and Recovery Information System | Entire Hovey Lake Peninsula and a 1.0 mile buffer beyond the project boundary. |
| **SHWS:** State Hazardous Waste Sites | Entire Hovey Lake Peninsula and a 1.0 mile buffer beyond the project boundary. |
| **CERCLIS:** Comprehensive Environmental Response, Compensation, and Liability Information System | Entire Hovey Lake Peninsula and a 1.0 mile buffer beyond the project boundary. |
| **CORRACTS:** Corrective Action Report | Entire Hovey Lake Peninsula and a 1.0 mile buffer beyond the project boundary. |
| **SWF/LF:** Available Disposal for Solid Waste in Illinois- Solid Waste Landfills Subject to State Surcharge | Entire Hovey Lake Peninsula and a 1.0 mile buffer beyond the project boundary. |
| **LUST:** Leaking Underground Storage Tank | Entire Hovey Lake Peninsula and a 1.0 mile buffer beyond the project boundary. |
| **UST:** Underground Storage Tank | Entire Hovey Lake Peninsula and a 1.0 mile buffer beyond the project boundary. |
| **RCRIS-SQG:** Resource Conservation and Recovery Information System for Small Quantity Generators | Entire Hovey Lake Peninsula and a 1.0 mile buffer beyond the project boundary. |
| **RCRIS-LQG:** Resource Conservation and Recovery Information System for Large Quantity Generators | Entire Hovey Lake Peninsula and a 1.0 mile buffer beyond the project boundary. |
| **ROD:** Record of Decision | Entire Hovey Lake Peninsula and a 1.0 mile buffer beyond the project boundary. |
| **CONSENT:** Superfund (CERCLA) Consent Decrees | Entire Hovey Lake Peninsula and a 1.0 mile buffer beyond the project boundary. |
| **Coal Gas:** Former Manufactured gas (Coal Gas) Sites | Entire Hovey Lake Peninsula and a 1.0 mile buffer beyond the project boundary. |
| **MINES:** Mines Master Index File | Entire Hovey Lake Peninsula and a 1.0 mile buffer beyond the project boundary. |

The HTRW database search did not reveal negative environmental conditions in the project area in Indiana. The database search also included areas across the Ohio River in Kentucky. Environmental conditions in Kentucky included a coal mine, and one RCRA small quantity generator. The database search identified various environmental conditions such as USTs, LUSTs, CERCLA sites and landfills beyond the one mile buffer zone surrounding the Hovey Lake peninsula project area.

**HTRW Findings and Conclusions.** Oil wells observed during the site inspection are a potential source of hydrocarbon contamination of groundwater from well casings that may have

leaked over time. Soils around oil production areas have the potential for contamination from buried drill muds and cuttings at drilling sites, produced water spills at oil/water separators, spills/discharges of sludges and water from storage tanks, and oily waste/sludges in abandoned production pits. With the exception of potential hydrocarbon, and drill muds and cuttings contamination at petroleum production sites, the site inspection and search of environmental records have revealed no other evidence of recognized HTRW problems in connection with this project site.

## 16.0 References


| **References:** | |
|---|---|
| Scott, 1989 | Scott, M.T. and L.A. Nielson. 1989. Young fish distribution in backwaters and main-channel borders of the Kanawha River, West Virginia. Journal of Fisheries Biology No. 35 (Supplement A) pp. 21-27. |
| Sheaffer, 1986 | Sheaffer, W.A. and J.G. Nickum. 1986. Backwater areas as nursery habitats for fishes in Pool 13 of the Upper Mississippi River. Hydrobiology No. 136 pp. 131-140. |
| Sheehan, 1994 | Sheehan, R.J., W.M. Lewis, and L.R. Bodensteiner. 1994. Winter habitat requirements and overwintering of riverine fishes. Fisheries Research Laboratory, Southern Illinois University, Carbondale, Illinois. Final Report F-79-R-6. |
| USFWS, 1999 | U.S. Fish and Wildlife Service, July 1, 1999. Federally Listed Endangered and Threatened Species in Indiana. |

## APPENDIX A Threatened & Endangered Species

July 1, 1999

ENDANGERED, THREATENED AND RARE SPECIES DOCUMENTED FROM POSEY COUNTY, INDIANA

| SPECIES NAME | COMMON NAME | FED | STATE | DATE |
|---|---|---|---|---|
| **Mammal** | | | | |
| LUTRA CANADENSIS | NORTHERN RIVER OTTER | ** | SE | 1991 |
| MYOTIS SODALIS | INDIANA BAT OR SOCIAL MYOTIS | LE | SE | 1996 |
| NYCTICEIUS HUMERALIS | EVENING BAT | ** | SE | 1996 |
| SYLVILAGUS AQUATICUS | SWAMP RABBIT | ** | SE | 1995 |
| TAXIDEA TAXUS | AMERICAN BADGER | ** | SE | 1987 |
| **Bird** | | | | |
| ARDEA ALBA | GREAT EGRET | ** | SSC | 1985 |
| ARDEA HERODIAS | GREAT BLUE HERON | ** | ** | 1950 |
| CERTHIA AMERICANA | BROWN CREEPER | ** | ** | 1983 |
| DENDROICA CERULEA | CERULEAN WARBLER | ** | SSC | 1979 |
| GAVIA IMMER | COMMON LOON | ** | SX | 1989 |
| HALIAEETUS LEUCOCEPHALUS | BALD EAGLE | LT | SE | 1998 |
| IXOBRYCHUS EXILIS | LEAST BITTERN | ** | SE | 1989 |
| LANIUS LUDOVICIANUS | LOGGERHEAD SHRIKE | ** | SE | 1988 |
| NYCTANASSA VIOLACEA | YELLOW-CROWNED NIGHT-HERON | ** | SE | 1985 |
| PANDION HALIAETUS | OSPREY | ** | SE | 1971 |
| PHALACROCORAX AURITUS | DOUBLE-CRESTED CORMORANT | ** | SX | 1953 |
| **Reptile** | | | | |
| CROTALUS HORRIDUS | TIMBER RATTLESNAKE | ** | SE | 1892 |
| KINOSTERNON SUBRUBRUM | EASTERN MUD TURTLE | ** | SE | 1986 |
| LIOCHLOROPHIS VERNALIS | SMOOTH GREEN SNAKE | ** | SE | 1892 |
| NERODIA ERYTHROGASTER NEGLECTA | COPPERBELLY WATER SNAKE | ** | SE | 1985 |
| PSEUDEMYS CONCINNA HIEROGLYPHICA | HIEROGLYPHIC RIVER COOTER | ** | SE | 1989 |
| THAMNOPHIS PROXIMUS | WESTERN RIBBON SNAKE | ** | SSC | 1892 |
| **Amphibian** | | | | |
| CRYPTOBRANCHUS ALLEGANIENSIS *LLEGANIENSIS | HELLBENDER | ** | SE | 1990 |
| **Fish** | | | | |
| ACIPENSER FULVESCENS | LAKE STURGEON | ** | SE | 1890 |
| CRYSTALLARIA ASPRELLA | CRYSTAL DARTER | ** | SSC | 1890 |
| CYCLEPTUS ELONGATUS | BLUE SUCKER | ** | SSC | 1993 |
| ETHEOSTOMA PELLUCIDUM | EASTERN SAND DARTER | ** | SSC | 1942 |
| ETHEOSTOMA SQUAMICEPS | SPOTTAIL DARTER | ** | SE | 1993 |
| PERCINA EVIDES | GILT DARTER | ** | SE | 1890 |
| PERCINA URANIDEA | STARGAZING DARTER | ** | SX | 1900 |
| **Crustacean** | | | | |
| ORCONECTES INDIANENSIS | INDIANA CRAYFISH | ** | SSC | 1974 |
| **Mussel** | | | | |
| ARCIDENS CONFRAGOSUS | ROCK-POCKETBOOK | ** | ** | 1987 |
| CUMBERLANDIA MONODONTA | SPECTACLECASE | ** | SX | 1987 |
| CYPROGENIA STEGARIA | EASTERN FANSHELL PEARLYMUSSEL | LE | SE | 1987 |
| EPIOBLASMA FLEXUOSA | LEAFSHELL | ** | SX | 1987 |
| EPIOBLASMA PROPINQUA | TENNESSEE RIFFLESHELL | ** | SX | 1987 |
| EPIOBLASMA SAMPSONII | WABASH RIFFLESHELL | ** | SX | 1944 |
| EPIOBLASMA TORULOSA TORULOSA | TUBERCLED BLOSSOM | LE | SE | 1987 |
| EPIOBLASMA TRIQUETRA | SNUFFBOX | ** | SE | 1987 |
| FUSCONAIA SUBROTUNDA | LONG-SOLID | ** | SE | 1903 |
| LAMPSILIS ABRUPTA | PINK MUCKET | LE | SE | 0000 |
| LAMPSILIS OVATA | POCKETBOOK | ** | ** | 1987 |
| LAMPSILIS TERES | YELLOW SANDSHELL | ** | ** | 1987 |
| LEPTODEA LEPTODON | SCALESHELL | ** | SX | 1976 |
| LIGUMIA RECTA | BLACK SANDSHELL | ** | ** | 1987 |
| OBOVARIA RETUSA | RING PINK | LE | SX | 1987 |
| OBOVARIA SUBROTUNDA | ROUND HICKORYNUT | ** | SSC | 1987 |
| PLETHOBASUS CICATRICOSUS | WHITE WARTYBACK | LE | SE | 1978 |
| PLETHOBASUS COOPERIANUS | ORANGE-FOOT PIMPLEBACK | LE | SE | 1944 |

STATE: SX=extirpated, SE=endangered, ST=threatened, SR=rare, SSC=special concern, WL=watch list, SG=significant, ** no status but rarity warrants concern

FEDERAL: LE=endangered, LT=threatened, LELT=different listings for specific ranges of species, PE=proposed endangered, PT=proposed threatened, E/SA=appearance similar to LE species, **=not listed

Page 1

July 1, 1999

ENDANGERED, THREATENED AND RARE SPECIES DOCUMENTED FROM POSEY COUNTY, INDIANA

| SPECIES NAME | COMMON NAME | FED | STATE | DATE |
|---|---|---|---|---|
| PLETHOBASUS CYPHYUS | SHEEPNOSE | ** | SE | 1987 |
| PLEUROBEMA CLAVA | CLUBSHELL | LE | SE | 1987 |
| PLEUROBEMA CORDATUM | OHIO PIGTOE | ** | SSC | 1987 |
| PLEUROBEMA PLENUM | ROUGH PIGTOE | LE | SE | 1944 |
| PLEUROBEMA PYRAMIDATUM | PYRAMID PIGTOE | ** | SE | 1987 |
| POTAMILUS CAPAX | FAT POCKETBOOK | LE | SE | 1995 |
| QUADRULA CYLINDRICA CYLINDRICA | RABBITSFOOT | ** | SE | 1987 |
| QUADRULA METANEVRA | MONKEYFACE | ** | ** | 1978 |
| QUADRULA NODULATA | WARTYBACK | ** | ** | 1978 |
| SIMPSONAIAS AMBIGUA | SALAMANDER MUSSEL | ** | SSC | 1976 |
| TOXOLASMA LIVIDUS | PURPLE LILLIPUT | ** | SSC | 1976 |
| TOXOLASMA PARVUM | LILLIPUT | ** | ** | 1976 |
| **Gastropod** | | | | |
| TRIODOPSIS OBSTRICTA | SHARP WEDGE | ** | SE | 1993 |
| **Lepidoptera: Butterflies, Skippers** | | | | |
| CYLLOPSIS GEMMA | GEMMED SATYR | ** | SR | 1994 |
| EUPHYES DUKESI | SCARCE SWAMP SKIPPER | ** | SR | 1995 |
| SATYRODES APPALACHIA APPALACHIA | APPALACHIAN EYED BROWN | ** | SE | 1995 |
| **Lepidoptera: Moths** | | | | |
| CATOCALA MARMORATA | MARBLED UNDERWING MOTH | ** | ** | 1996 |
| EOSPHOROPTERYX THYATYROIDES | PINKPATCHED LOOPER MOTH | ** | ST | 1995 |
| **Coleoptera: Beetles** | | | | |
| NICROPHORUS AMERICANUS | AMERICAN BURYING BEETLE | LE | SX | 1965 |
| **Ephemeroptera: Mayflies** | | | | |
| PENTAGENIA VITTIGERA | A PENTAGENIAN BURROWING MAYFLY | ** | ST | 1974 |
| TORTOPUS PRIMUS | A MAYFLY | ** | ST | 1974 |
| **Vascular Plant** | | | | |
| AZOLLA CAROLINIANA | CAROLINA MOSQUITO-FERN | ** | ST | 1991 |
| CALYCOCARPUM LYONII | CUP-SEED | ** | ST | 1986 |
| CAREX BUSHII | BUSH'S SEDGE | ** | SE | 1993 |
| CAREX GIGANTEA | LARGE SEDGE | ** | SE | 1991 |
| CAREX LUPULIFORMIS | FALSE HOP SEDGE | ** | SR | 1991 |
| CAREX SOCIALIS | SOCIAL SEDGE | ** | SR | 1993 |
| CATALPA SPECIOSA | NORTHERN CATALPA | ** | SR | 1906 |
| CIMICIFUGA RUBIFOLIA | APPALACHIAN BUGBANE | ** | SE | 1993 |
| CLEMATIS PITCHERI | PITCHER LEATHER-FLOWER | ** | SR | 1915 |
| CRATAEGUS VIRIDIS | GREEN HAWTHORN | ** | ST | 1918 |
| CUSCUTA CUSPIDATA | CUSP DODDER | ** | SX | 1920 |
| CYPERUS PSEUDOVEGETUS | GREEN FLATSEDGE | ** | SR | 1991 |
| DIDIPLIS DIANDRA | WATER-PURSLANE | ** | SR | 1934 |
| DIERVILLA LONICERA | NORTHERN BUSH-HONEYSUCKLE | ** | SR | 1932 |
| ECHINODORUS CORDIFOLIUS | CREEPING BUR-HEAD | ** | SX | 1916 |
| ELEOCHARIS WOLFII | WOLF SPIKERUSH | ** | SR | 1987 |
| EUPHORBIA OBTUSATA | BLUNTLEAF SPURGE | ** | SX | 1980 |
| FESTUCA PARADOXA | CLUSTER FESCUE | ** | SE | 1991 |
| GLEDITSIA AQUATICA | WATER-LOCUST | ** | SE | 1981 |
| HOTTONIA INFLATA | FEATHERFOIL | ** | ST | 1982 |
| HYPERICUM DENTICULATUM | COPPERY ST. JOHN'S-WORT | ** | ST | 1929 |
| IRESINE RHIZOMATOSA | EASTERN BLOODLEAF | ** | SR | 1995 |
| ISOETES MELANOPODA | BLACKFOOT QUILLWORT | ** | SE | 1993 |
| LEMNA MINIMA | LEAST DUCKWEED | ** | SE | 1981 |
| LEPTOCHLOA PANICOIDES | AMAZON SPRANGLE-TOP | ** | SE | 1991 |
| LESPEDEZA STUEVEI | TALL BUSH-CLOVER | ** | SX | 1926 |
| LESQUERELLA GLOBOSA | LESQUEREUX'S MUSTARD | ** | SE | 1985 |
| LUDWIGIA DECURRENS | PRIMROSE WILLOW | ** | SR | 1991 |
| LUDWIGIA GLANDULOSA | CYLINDRIC-FRUITED SEEDBOX | ** | ST | 1991 |
| MONARDA BRADBURIANA | EASTERN BEE-BALM | ** | SE | 1993 |

STATE: SX=extirpated, SE=endangered, ST=threatened, SR=rare, SSC=special concern, WL=watch list, SG=significant, no status but rarity warrants concern

FEDERAL: LE=endangered, LT=threatened, LELT=different listings for specific ranges of species, PE=proposed endangered, PT=proposed threatened, E/SA=appearance similar to LE species, **=not listed

July 1, 1999

ENDANGERED, THREATENED AND RARE SPECIES DOCUMENTED FROM POSEY COUNTY, INDIANA

| SPECIES NAME | COMMON NAME | FED | STATE | DATE |
|---|---|---|---|---|
| NOTHOSCORDUM BIVALVE | CROW-POISON | ** | SR | 1985 |
| PANICUM SCOPARIUM | BROOM PANIC-GRASS | ** | SE | 1982 |
| PERIDERIDIA AMERICANA | EASTERN EULOPHUS | ** | SE | 1985 |
| PLATANTHERA FLAVA VAR FLAVA | SOUTHERN REIN ORCHID | ** | SE | 1923 |
| PRENANTHES ASPERA | ROUGH RATTLESNAKE-ROOT | ** | SR | 1991 |
| RANUNCULUS LAXICAULIS | MISSISSIPPI BUTTERCUP | ** | SE | 1993 |
| RANUNCULUS PUSILLUS | PURSH BUTTERCUP | ** | SE | 1993 |
| RHYNCHOSPORA CORNICULATA VAR INTERIOR | SHORT-BRISTLE HORNED-RUSH | ** | ST | 1991 |
| RUBUS ALUMNUS | A BRAMBLE | ** | SX | 1911 |
| RUBUS IMPAR | A BRAMBLE | ** | SX | 1934 |
| SCUTELLARIA PARVULA VAR AUSTRALIS | SOUTHERN SKULLCAP | ** | SR | 1983 |
| SOLIDAGO BUCKLEYI | BUCKLEY'S GOLDENROD | ** | SE | 1995 |
| SPIGELIA MARILANDICA | WOODLAND PINKROOT | ** | SE | 1992 |
| TAXODIUM DISTICHUM | BALD CYPRESS | ** | ST | 1994 |
| THALICTRUM PUBESCENS | TALL MEADOWRUE | ** | ST | 1911 |
| TRACHELOSPERMUM DIFFORME | CLIMBING DOGBANE | ** | SR | 1983 |
| TRIFOLIUM REFLEXUM VAR GLABRUM | BUFFALO CLOVER | ** | SE | 1987 |
| VITIS PALMATA | CATBIRD GRAPE | ** | SR | 1992 |
| WISTERIA MACROSTACHYA | KENTUCKY WISTERIA | ** | SR | 1993 |
| **High Quality Natural Community** | | | | |
| FOREST - FLATWOODS SOUTHWESTERN LOWLAND MESIC | MESIC SOUTHWESTERN LOWLAND FLATWOODS | ** | SG | 1991 |
| FOREST - FLOODPLAIN WET-MESIC | WET-MESIC FLOODPLAIN FOREST | ** | SG | 1989 |
| FOREST - UPLAND MESIC | MESIC UPLAND FOREST | ** | SG | 1983 |
| WETLAND - SWAMP FOREST | FORESTED SWAMP | ** | SG | 1994 |
| WETLAND - SWAMP SHRUB | SHRUB SWAMP | ** | SG | 1996 |

STATE: SX=extirpated, SE=endangered, ST=threatened, SR=rare, SSC=special concern, WL=watch list, SG=significant, ** no status but rarity warrants concern

FEDERAL: LE=endangered, LT=threatened, LELT=different listings for specific ranges of species, PE=proposed endangered, PT=proposed threatened, E/SA=appearance similar to LE species, **=not listed

Page 3

## APPENDIX B Hazardous Toxic and Radiological Wastes

# The EDR Area Study Report

Study Area
Hovey Lake
Uniontown, Kentucky

July 12, 1999

Inquiry number 389093.1s

Environmental Data Resources, Inc.
an edr company

*The* Source For Environmental Risk Management Data

3530 Post Road
Southport, Connecticut 06490

**Nationwide Customer Service**

Telephone: 1-800-352-0050
Fax: 1-800-231-6802
Internet: www.edrnet.com

# EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc. (EDR).

The address of the subject property for which the search was intended is:

HOVEY LAKE
UNIONTOWN, KY 42461

No mapped sites were found in EDR's search of available ( "reasonably ascertainable ") government records within the requested search area for the following Databases:

| | |
|---|---|
| NPL: | National Priority List |
| Delisted NPL: | NPL Deletions |
| RCRIS-TSD: | Resource Conservation and Recovery Information System |
| SHWS: | State Haz. Waste |
| CERCLIS: | Comprehensive Environmental Response, Compensation, and Liability Information System |
| CERC-NFRAP: | Comprehensive Environmental Response, Compensation, and Liability Information System |
| CORRACTS: | Corrective Action Report |
| SWF/LF: | Solid Waste Facilities List |
| UST: | Underground Storage Tank Database |
| RAATS: | RCRA Administrative Action Tracking System |
| RCRIS-LQG: | Resource Conservation and Recovery Information System |
| HMIRS: | Hazardous Materials Information Reporting System |
| PADS: | PCB Activity Database System |
| ERNS: | Emergency Response Notification System |
| TRIS: | Toxic Chemical Release Inventory System |
| NPL Lien: | NPL Liens |
| TSCA: | Toxic Substances Control Act |
| MLTS: | Material Licensing Tracking System |
| ROD: | ROD |
| CONSENT: | Superfund (CERCLA) Consent Decrees |

Unmapped (orphan) sites are not considered in the foregoing analysis.

# EXECUTIVE SUMMARY

## Search Results:

Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

**RCRIS:** The Resource Conservation and Recovery Act database includes selected information on sites that generate, store, treat, or dispose of hazardous waste as defined by the Act. The source of this database is the U.S. EPA.

A review of the RCRIS-SQG list, as provided by EDR, and dated 04/26/1999 has revealed that there is 1 RCRIS-SQG site within the searched area.

| Site | Address | Map ID | Page |
|---|---|---|---|
| ***UNION CO GAS & OIL CO*** | ***5TH & MILL ST*** | *1* | *2* |

**FINDS:** The Facility Index System contains both facility information and "pointers" to other sources of information that contain more detail. These include: RCRIS; Permit Compliance System (PCS); Aerometric Information Retrieval System (AIRS); FATES (FIFRA [Federal Insecticide Fungicide Rodenticide Act] and TSCA Enforcement System, FTTS [FIFRA/TSCA Tracking System]; CERCLIS; DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes); Federal Underground Injection Control (FURS); Federal Reporting Data System (FRDS); Surface Impoundments (SIA); TSCA Chemicals in Commerce Information System (CICS); PADS; RCRA-J (medical waste transporters/disposers); TRIS; and TSCA. The source of this database is the U.S. EPA/NTIS.

A review of the FINDS list, as provided by EDR, and dated 04/01/1999 has revealed that there is 1 FINDS site within the searched area.

| Site | Address | Map ID | Page |
|---|---|---|---|
| ***UNION CO GAS & OIL CO*** | ***5TH & MILL ST*** | *1* | *2* |

**Mines:** Mines Master Index File. The source of this database is the Dept. of Labor, Mine Safety and Health Administration.

A review of the MINES list, as provided by EDR, and dated 08/01/1998 has revealed that there is 1 MINES site within the searched area.

| Site | Address | Map ID | Page |
|---|---|---|---|
| ISLAND CREEK COAL COMPANY | | 2 | 2 |

## EXECUTIVE SUMMARY

Please refer to the end of the findings report for unmapped orphan sites due to poor or inadequate address information.

## MAP FINDINGS SUMMARY

| Database | Total Plotted |
|---|---|
| NPL | 0 |
| Delisted NPL | 0 |
| RCRIS-TSD | 0 |
| State Haz. Waste | 0 |
| CERCLIS | 0 |
| CERC-NFRAP | 0 |
| CORRACTS | 0 |
| State Landfill | 0 |
| LUST | N/A |
| UST | 0 |
| RAATS | 0 |
| RCRIS Sm. Quan. Gen. | 1 |
| RCRIS Lg. Quan. Gen. | 0 |
| HMIRS | 0 |
| PADS | 0 |
| ERNS | 0 |
| FINDS | 1 |
| TRIS | 0 |
| NPL Liens | 0 |
| TSCA | 0 |
| MLTS | 0 |
| ROD | 0 |
| CONSENT | 0 |
| MINES | 1 |

* Sites may be listed in more than one database

MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site

EDR ID Number
Database(s) EPA ID Number

**Coal Gas Site Search: EDR does not presently have coal gas site information available in this state.**

1 **UNION CO GAS & OIL CO**
**5TH & MILL ST**
**UNIONTOWN, KY 42461**

RCRIS-SQG 1001196263
FINDS KYR000009985

RCRIS:
Owner: DARNELL SMITH
(502) 389-4611
Contact: DARNELL SMITH
(502) 389-4611
Record Date: 04/07/1997
Classification: Not reported
Used Oil Recyc: No
Violation Status: No violations found

2 **ISLAND CREEK COAL COMPANY**

MINES M000006956
N/A

**UNION (County), KY**

U.S. MINES:
Mine ID: 1503178
Entity Name: OHIO # 11
State FIPS code: 21
Status Date: 12/16/1993
Operation Class: Coal mining
Number of Pits: 000
Latitude: 37 45 36

SIC Codes: 12110
Company: ISLAND CREEK COAL COMPANY
County FIPS code: 225
Status: Active
Number of Shops: 0
Number of Plants: 0
Longitude: 087 56 50

| City | EDR ID | Site Name | Site Address | Zip | Database(s) | Facility ID |
|---|---|---|---|---|---|---|
| MORGANFIELD | 1000826635 | PEABODY COAL CO/CAMP TERMINAL | HIGHWAY 360 | 42437 | RCRIS-SQG, FINDS | |
| MORGANFIELD | U000205413 | HAMILTON NO 2 MINE | HWY 360 | 42437 | UST | 8272113 |
| MORGANFIELD | 1000336003 | UNION CO. AREA VOCATIONAL CTR | R.R. 4 | 42437 | RCRIS-SQG, FINDS | |
| MORGANFIELD | 1000429275 | MO-VAC | HWY. 56 WEST | 42437 | RCRIS-SQG, FINDS | |
| MORGANFIELD | 1000112598 | UNITED TECHNOLOGIES AUTOMOTIVE | HIGHWAY 60 EAST | 42437 | CORRACTS, RCRIS-SQG, SHWS, FINDS, RCRIS-TSD | B3067 |
| MORGANFIELD | 1000113887 | CPS FARM CENTER - MORGANFIELD | HWY 60 WEST, 4 MI | 42437 | RCRIS-SQG, FINDS | |
| MORGANFIELD | 1000151698 | ISLAND CREEK COAL CO | HWY 60 S | 42437 | CERC-NFRAP, FINDS | |
| MORGANFIELD | 1000290121 | RAYLOC | 3710 HWY 60 EAST | 42437 | FINDS, RCRIS-LQG, UST | 4221113 |
| MORGANFIELD | S103594111 | EARL C. CLEMENTS JOB CORPS LANDFILL | 2302 HIGHWAY 60 | 42437 | SWF/LF | 11300006 |
| MORGANFIELD | S103594112 | LARRY'S TOPCAT | HIGHWAY 60 NORTH | 42437 | SWF/LF | 11300010 |
| MORGANFIELD | U000811120 | FOEMAN SHELTON DISTR INC | HWY 60 W | 42437 | UST | 8375113 |
| MORGANFIELD | U001180524 | SHELLER-GLOBE CORP | HWY 60 E | 42437 | UST | 1880113 |
| MORGANFIELD | U001180658 | MORGANS GAS & OIL INC | HWY 60 N | 42437 | UST | 2012113 |
| MORGANFIELD | U001185112 | HAMILTON NO 1 | HWY 871 | 42437 | UST | 8271113 |
| MORGANFIELD | U001442197 | UNION COUNTY/MAINT GARAGE | BEAVER DAM RD | 42437 | UST | 755113 |
| MORGANFIELD | U000721679 | PHILS PICK EM UP | US HWY 60 N | 42437 | UST | 6618113 |
| MORGANFIELD | 1000125598 | SUN OIL CO CAMP BRECKINRIDGE | N OF SR 56 7.5 MI SE OF | 42437 | CERC-NFRAP, RCRIS-SQG, FINDS | |
| MORGANFIELD | 1000125599 | SUN OIL CO CP BRECKINRIDGE OFF WHSE | ONE MI S OF US HWY 60 E | 42437 | CERC-NFRAP, RCRIS-SQG, FINDS | |
| MORGANFIELD | U002176998 | BUDS COUNTRY CORNER | 8052 ST RD 141 S & 56 W | 42437 | UST | 1004113 |
| MORGANFIELD | S103594109 | DOZIT COMPANY INC SANITARY LANDFILL | 4075 STATE ROUTE 360 | 42437 | SWF/LF | 11300005 |
| MORGANFIELD | S103594110 | DOZIT COMPANY INC SANITARY LANDFILL | 4075 STATE ROUTE 360 | 42437 | SWF/LF | |
| MORGANFIELD | U002252692 | CITY OF MORGANFIELD STREET DEPT | W WAVERLY ST | 42437 | UST | 1009113 |
| MORGANTOWN | U000205613 | JOSEPH W SPRAGUE | ROUTE 5 | 42437 | UST | 1868113 |
| MOUNT VERNON | 1000144623 | TEXACO USA MT VERNON TERMINAL | W 2ND ST | 47620 | RCRIS-SQG, FINDS | |
| MOUNT VERNON | U001082231 | PLATOLENE '500' INC | 606 N 4TH ST | 47620 | UST | 017772 |
| MOUNT VERNON | U001082241 | PLATOLENE "500" INC | 602 N 4TH ST | 47620 | UST | 017846 |
| MOUNT VERNON | 1000464343 | MEAD JOHNSON NUTRITIONALS | HWY 62 E | 47620 | RCRIS-SQG, FINDS | |
| MOUNT VERNON | U000182004 | SCHILLI LEASING | SR 62 W | 47620 | UST | 000498 |
| MOUNT VERNON | U000185786 | J & J WELDING INC | SR 62 W | 47620 | UST | 004756 |
| MOUNT VERNON | U000194466 | BRISTOL-MYERS MT VERNON PARK | HWY 62 E | 47620 | UST | 017363 |
| MOUNT VERNON | U001078298 | KMART 9014 | SR 62 E | 47620 | UST | 005051 |
| MOUNT VERNON | U003093652 | MEAD JOHNSON & COMPANY | SR 62 E | 47620 | UST | 006034 |
| MOUNT VERNON | 1000255930 | CF INDUSTRIES MT VERNON TERMINAL | HWY 69 S | 47620 | RCRIS-SQG, FINDS, UST | 009008 |
| MOUNT VERNON | 1000512215 | M G INDUSTRIES | SR 69 S & SR 62 | 47620 | FINDS, LUST, UST | 005890 |
| MOUNT VERNON | U000194297 | MESSER GRIESHEIM INDUSTRIES INC | HWY 69 S & HOLLER RD | 47620 | UST | 017070 |
| MOUNT VERNON | U001078160 | DNR HOVEY LAKE FISH & WILDLIFE | 1298 W GRADDY RD | 47620 | LUST, UST | 004133 |
| MOUNT VERNON | 1000312335 | PIONEER HI BRED INTERNATIONAL INC | OLD HWY 62 E | 47620 | RCRIS-SQG, FINDS | |
| MOUNT VERNON | U003294621 | MT VERNON TERMINAL | OLD SR 69 S | 47620 | LUST, UST | 006835 |
| MOUNT VERNON | 1000213105 | GENERAL ELECTRIC CO | ONE LEXAN LN | 47620 | CORRACTS, CERC-NFRAP, PADS, FINDS, RCRIS-LQG, MLTS, TRIS, RCRIS-TSD, RAATS | |
| MOUNT VERNON | U001079524 | WEINYAPFEL & SONS INC | ST PHILIP'S RD | 47620 | UST | 007314 |

ORPH[illegible]UMMARY

| City | EDR ID | Site Name | Site Address | Zip | Database(s) | Facility ID |
|---|---|---|---|---|---|---|
| MT VERNON | 1000156505 | MCCARTY SAN LDFL 1 | HWY 62 & RABEN RD | 47620 | CERC-NFRAP, FINDS | |
| MT VERNON | 1000464291 | NORTH AMERICAN PIPE CORP | HWY 62 E, PO BOX 567 | 47620 | RCRIS-SQG, FINDS | |
| MT VERNON | 1000156506 | MCCARTY'S BALD KNOB LANDFILL | BALD KNOB RD | 47620 | CERCLIS, FINDS | |
| MT VERNON | 1000987056 | WARTSILA NSD NA INC MT VERNON OPER | 1410 OLD HWY 69 | 47620 | RCRIS-SQG, FINDS | |
| MT VERNON | 1001404679 | WAREHOUSE SVCS LLC NO 5 | 2301 OLD HWY 62 | 47620 | RCRIS-SQG, FINDS | |
| MT VERNON | 1000863193 | INDOT | M20657 SR 62 AT IN IL ST LINE | 47620 | RCRIS-SQG, FINDS | |
| POSEY | U000185629 | MT VERNON UNIT | SR 69 1 MILE S OF MT VERNON | 47620 | UST | 003671 |
| SOLITUDE | 1000104239 | IND BELL TEL CO SOLITUDE 783 O | ST RD 69 | 47620 | RCRIS-SQG, FINDS | |
| ST PHILIP | U003093272 | BUSLER ENTERPRISES INC | SR 62 | 47620 | UST | 002711 |
| ST PHILLIP | 1000104291 | IND BELL TEL CO ST PHILLIP 985 | ST PHILLIP RD AND CTY RD | 47620 | RCRIS-SQG, FINDS | |
| UNION | U002177012 | THE PIT STOP | 14 ST RT 2835 | 42437 | UST | 1005113 |
| UNIONTOWN | 1001196262 | WILLIAM HARRIS PROPERTY | 4852 SR 130 N | 42461 | RCRIS-SQG, FINDS | |
| UNIONTOWN | S103594114 | UNIONTOWN DEMOLITION LANDFILL | HIGHWAY 130 E OF UNIONTOWN | 42461 | SWF/LF | 11300013 |
| UNIONTOWN | U001185113 | OHIO NO 11 MINE | HWY 360 | 42461 | UST | 8273113 |
| UNIONTOWN | U000811122 | PEABODY CAMP TERMINAL | KY HWY 360 | 42461 | UST | 8379113 |
| UNIONTOWN | 1000516855 | WABASH ELEVATOR CO | MADISON ST | 42461 | UST | 1052113 |
| UNIONTOWN | U001623937 | UNION CO GAS & OIL | 5TH MILL ST | 42461 | UST | 5393113 |
| UNIONTOWN | U003132040 | WILLIAM HARRIS PROPERTY | UNIONTOWN 4852 SR 130 N | 42461 | UST | 1015113 |
| UNIONTOWN | U000205184 | FERGYS MARKET | UPPER MAIN & MADISON | 42461 | UST | 5475113 |

## GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

**Elapsed ASTM days:** Provides confirmation that this EDR report meets or exceeds the 90-day updating requirement of the ASTM standard.

**FEDERAL ASTM RECORDS:**

**CERCLIS:** Comprehensive Environmental Response, Compensation, and Liability Information System
Source: EPA
Telephone: 703-413-0223
CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 04/21/99
Date Made Active at EDR: 06/09/99
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 05/14/99
Elapsed ASTM days: 26
Date of Last EDR Contact: 05/14/99

**ERNS:** Emergency Response Notification System
Source: EPA/NTIS
Telephone: 202-260-2342
Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 12/31/98
Date Made Active at EDR: 01/18/99
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 01/13/99
Elapsed ASTM days: 5
Date of Last EDR Contact: 05/12/99

**NPL:** National Priority List
Source: EPA
Telephone: N/A
National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC).

Date of Government Version: 05/10/99
Date Made Active at EDR: 06/09/99
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 05/12/99
Elapsed ASTM days: 28
Date of Last EDR Contact: 05/12/99

**RCRIS:** Resource Conservation and Recovery Information System
Source: EPA/NTIS
Telephone: 800-424-9346
Resource Conservation and Recovery Information System. RCRIS includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA).

Date of Government Version: 04/26/99
Date Made Active at EDR: 06/09/99
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 05/14/99
Elapsed ASTM days: 26
Date of Last EDR Contact: 05/14/99

**CORRACTS:** Corrective Action Report
Source: EPA
Telephone: 800-424-9346
CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 03/01/99
Date Made Active at EDR: 04/16/99
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 03/17/99
Elapsed ASTM days: 30
Date of Last EDR Contact: 06/21/99

## GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

**FEDERAL NON-ASTM RECORDS:**

**BRS:** Biennial Reporting System
Source: EPA/NTIS
Telephone: 800-424-9346
The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/95
Database Release Frequency: Biennially

Date of Last EDR Contact: 03/25/99
Date of Next Scheduled EDR Contact: 06/21/99

**CONSENT:** Superfund (CERCLA) Consent Decrees
Source: EPA Regional Offices
Telephone: Varies
Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: Varies
Database Release Frequency: Varies

Date of Last EDR Contact: Varies
Date of Next Scheduled EDR Contact: N/A

**FINDS:** Facility Index System/Facility Identification Initiative Program Summary Report
Source: EPA
Telephone: N/A
Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 04/01/99
Database Release Frequency: Quarterly

Date of Last EDR Contact: 04/16/99
Date of Next Scheduled EDR Contact: 07/12/99

**HMIRS:** Hazardous Materials Information Reporting System
Source: U.S. Department of Transportation
Telephone: 202-366-4526
Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 12/31/97
Database Release Frequency: Annually

Date of Last EDR Contact: 03/24/99
Date of Next Scheduled EDR Contact: 07/26/99

**MLTS:** Material Licensing Tracking System
Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 12/08/98
Database Release Frequency: Quarterly

Date of Last EDR Contact: 04/13/99
Date of Next Scheduled EDR Contact: 07/12/99

**NPL LIENS:** Federal Superfund Liens
Source: EPA
Telephone: 205-564-4267
Federal Superfund Liens. Under the authority granted the USEPA by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner receives notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/91
Database Release Frequency: No Update Planned

Date of Last EDR Contact: 05/28/98
Date of Next Scheduled EDR Contact: 08/23/99

## GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

**PADS:** PCB Activity Database System
Source: EPA
Telephone: 202-260-3936
PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 09/22/97
Database Release Frequency: No Update Planned

Date of Last EDR Contact: 05/27/99
Date of Next Scheduled EDR Contact: 08/16/99

**RAATS:** RCRA Administrative Action Tracking System
Source: EPA
Telephone: 202-564-4104
RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/95
Database Release Frequency: No Update Planned

Date of Last EDR Contact: 06/14/99
Date of Next Scheduled EDR Contact: 09/13/99

**ROD:** Records Of Decision
Source: NTIS
Telephone: 703-416-0223
Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 01/31/99
Database Release Frequency: Annually

Date of Last EDR Contact: 05/25/99
Date of Next Scheduled EDR Contact: 07/19/99

**TRIS:** Toxic Chemical Release Inventory System
Source: EPA
Telephone: 202-260-1531
Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/97
Database Release Frequency: Annually

Date of Last EDR Contact: 05/07/99
Date of Next Scheduled EDR Contact: 06/28/99

**TSCA:** Toxic Substances Control Act
Source: EPA
Telephone: 202-260-1444
Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/94
Database Release Frequency: Every 4 Years

Date of Last EDR Contact: 04/26/99
Date of Next Scheduled EDR Contact: 07/26/99

**MINES:** Mines Master Index File
Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959

Date of Government Version: 08/01/98
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 04/08/99
Date of Next Scheduled EDR Contact: 07/05/99

## GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

**STATE OF KENTUCKY ASTM RECORDS:**

**LUST:** N/A
Source: Department of Environmental Protection
Telephone: 502-564-6716
Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.

Date of Government Version: N/A
Date Made Active at EDR: N/A
Database Release Frequency: No Update Planned

Date of Data Arrival at EDR: N/A
Elapsed ASTM days: 0
Date of Last EDR Contact: 05/18/99

**SHWS:** State Leads List
Source: Department of Environmental Protection
Telephone: 502-564-6716
State Hazardous Waste Sites. State hazardous waste site records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. Available information varies by state.

Date of Government Version: 12/28/98
Date Made Active at EDR: 02/15/99
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 01/14/99
Elapsed ASTM days: 32
Date of Last EDR Contact: 04/05/99

**LF:** Solid Waste Facilities List
Source: Department of Environmental Protection
Telephone: 502-564-6716
Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 02/01/99
Date Made Active at EDR: 04/01/99
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 03/01/99
Elapsed ASTM days: 31
Date of Last EDR Contact: 05/24/99

**UST:** Underground Storage Tank Database
Source: Department of Environmental Protection
Telephone: 502-564-6716
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 02/08/99
Date Made Active at EDR: 06/17/99
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 05/18/99
Elapsed ASTM days: 30
Date of Last EDR Contact: 04/05/99

### Historical and Other Database(s)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

## GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

**Former Manufactured Gas (Coal Gas) Sites:** The existence and location of Coal Gas sites is provided exclusively to EDR by Real Property Scan, Inc. ©Copyright 1993 Real Property Scan, Inc. For a technical description of the types of hazards which may be found at such sites, contact your EDR customer service representative.

**Disclaimer Provided by Real Property Scan, Inc.**

The information contained in this report has predominantly been obtained from publicly available sources produced by entities other than Real Property Scan. While reasonable steps have been taken to insure the accuracy of this report, Real Property Scan does not guarantee the accuracy of this report. Any liability on the part of Real Property Scan is strictly limited to a refund of the amount paid. No claim is made for the actual existence of toxins at any site. This report does not constitute a legal opinion.

**DELISTED NPL:** NPL Deletions
Source: EPA
Telephone: N/A
The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 04/23/99
Date Made Active at EDR: 05/09/99
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 05/12/99
Elapsed ASTM days: 28
Date of Last EDR Contact: 02/08/99

**NFRAP:** No Further Remedial Action Planned
Source: EPA
Telephone: 703-413-0223
As of February 1995, CERCLIS sites designated "No Further Remedial Action Planned" (NFRAP) have been removed from CERCLIS. NFRAP sites may be sites where, following an initial investigation, no contamination was found, contamination was removed quickly without the need for the site to be placed on the NPL, or the contamination was not serious enough to require Federal Superfund action or NPL consideration. EPA has removed approximately 25,000 NFRAP sites to lift the unintended barriers to the redevelopment of these properties and has archived them as historical records so EPA does not needlessly repeat the investigations in the future. This policy change is part of the EPA's Brownfields Redevelopment Program to help cities, states, private investors and affected citizens to promote economic redevelopment of unproductive urban sites.

Date of Government Version: 04/21/99
Date Made Active at EDR: 05/09/99
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 05/14/99
Elapsed ASTM days: 26
Date of Last EDR Contact: 05/14/99

**PWS:** Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-260-2805
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

**PWS ENF:** Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-260-2805
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SWDIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

**Area Radon Information:** The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

**EPA Radon Zones:** Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

## GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

**Oil/Gas Pipelines/Electrical Transmission Lines:** This data was obtained by EDR from the USGS in 1994. It is referred to by USGS as GeoData Digital Line Graphs from 1:100,000-Scale Maps. It was extracted from the transportation category including some oil, but primarily gas pipelines and electrical transmission lines.

**Sensitive Receptors:** There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

**USGS Water Wells:** In November 1971 the United States Geological Survey (USGS) implemented a national water resource information tracking system. This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on more than 900,000 wells, springs, and other sources of groundwater.

**Flood Zone Data:** This data, available in select counties across the country, was obtained by EDR in 1999 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

**NWI:** National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in March 1997 from the U.S. Fish and Wildlife Service.

**Epicenters:** World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

**Water Dams:** National Inventory of Dams
Source: Federal Emergency Management Agency
Telephone: 202-646-2801
National computer database of more than 74,000 dams maintained by the Federal Emergency Management Agency.

**Kentucky Well Data Files**
Source: University of Kentucky, Geological Survey
Telephone: 606-257-5500

*Thank you for your business.*
Please contact EDR at 1-800-352-0050
with any questions or comments.

**Disclaimer**

This Report contains information obtained from a variety of public sources and EDR makes no representation or warranty regarding the accuracy, reliability, quality, or completeness of said information or the information contained in this report. The customer shall assume full responsibility for the use of this report.
**No warranty of merchantability or of fitness for a particular purpose, expressed or implied, shall apply and EDR specifically disclaims the making of such warranties. In no event shall EDR be liable to anyone for special, incidental, consequential or exemplary damages.**

**APPENDIX C Plan Formulation and Incremental Analysis Checklist**

**Project Site Location:**

The proposed Hovey Lake Restoration Project area is located at the State of Indiana's Hovey Lake Fish and Wildlife Management Area (FWA). The Hovey Lake project area is located in rural Posey County, Indiana approximately 7 miles south of the town of Mt. Vernon, Indiana. The project site is located in the J. T. Myers Pool near Ohio River Miles (ORM) 835-841. Hovey Lake is within the jurisdiction of the Louisville District, U.S. Army Corps of Engineers (USACE).

**Description of Plan Selected:** The elements of the Hovey Lake Restoration Project are:
Restoration of Oxbow Habitat. The aquatic habitat at Hovey Lake will be restored by dredging 50% of the 300-acre open basin to an average depth of 20 feet at normal pool.
Shoreline Stabilization. The Ohio River shoreline north of the lake is unstable and exhibits heavy bank erosion. This shoreline will be stabilized by installing "A-jacks®" structures. This will stabilize the banks and allow natural re-vegetation and subsequent erosion control to occur.
Reforestation. Reforestation of a parcel north of the lake will reduce erosion and slow flood waters allowing the sediment load to be dropped north of Hovey Lake rather than in the lake.

**Alternatives of the Selected Plan:**

Smaller Size Plans Possible? **Yes** and description

Reduce the amount of dredging, reforestation, and shoreline protection.

Larger Size Plan Possible? **Yes** and description

Increase the amount of dredging, reforestation, and shoreline protection.

Other alternatives? **No**

**Restore/Enhance/Protect Terrestrial Habitats?** Yes **Opportunity numbers met** T1, T3

**Restore, Enhance, & Protect Wetlands?** Yes **Opportunity numbers met** W2

**Restore/Enhance/Protect Aquatic Habitats?** Yes **Opportunity numbers met** A1, A8

**Type species benefited:** Fish and invertebrates.

**Endangered species benefited:** Potential benefits to Indiana bat and Bald eagle.

**Can estimated amount of habitat units be determined:** 145 acres of Hovey Lake Oxbow will be restored, 125 acres of riparian forest replanted, and 0.9 miles of shoreline protected.

**Plan acceptable to Resources Agencies?**
**U.S. Fish & Wildlife Service?**
**State Department of Natural Resources?** **Yes** – Indiana DNR

**Plan considered complete?** **Connected to other plans for restoration?**

**Real Estate owned by State Agency?** Some **Federal Agency?** Some
**Real Estate privately owned?** Some
**If privately owned, what is status of future acquisition**? Agreements or acquisition will be required.

## Terrestrial Habitat Opportunities

T1 Restore riparian corridors, reduce fragmentation by expanding and joining isolated habitat blocks and stabilize eroding banks.

T2 Restore, protect existing islands and create islands where they historically occurred.

T3 Restore hardwood forests in the 100-year floodplain.

## Wetland Habitat Opportunities

W1 Forested Wetlands: Restore Forested Wetlands: Bottomland Hardwoods

W2 Forested Wetlands: Restore Forested Wetlands:Cypress/Tupelo Swamps and other unique forested wetlands

W3 Restore Scrub/Shrub Emergent Wetlands: including those areas isolated from the river except during high water and those contiguous with embayments and island sloughs.

## Aquatic Habitat Opportunities

A1 Restore backwaters (Including sloughs, embayments, oxbows, bayous, etc.).

A2 Restore riverine submerged and emergent aquatic vegetation

A3 Restore and protect sand and gravel bars.

A4 Protect tailwaters and provide structures to provide refuge for fish.

A5 Create and protect fish and mussel refuges in pools (deep water, slow velocity, soft substrate)

A6 Restore and protect aquatic habitat (Side Channel/Back Channel Habitat)

**Other**

O-1 Restore other habitats(e.g., canebrakes, river bluffs mussel beds, etc.)

## APPENDIX D Micro Computer-Aided Cost Engineering System (MCACES)

---

# Hovey Lake Restoration
# Ohio River Mainstem
# Ecosystem Restoration Project

## Sample Feasibility Cost Estimate

| | |
|---|---|
| Designed By: | Parsons Engineering Science, Inc |
| Estimated By: | |
| Prepared By: | Parsons Engineering/CELRL-ED-MC |
| | CELRL-ED-MC POC: M. Lockard |
| Preparation Date: | 06/20/00 |
| Effective Date of Pricing: | 06/20/00 |
| Est Construction Time: | 365 Days |
| Sales Tax: | 5.00% |

M C A C E S  G O L D  E D I T I O N
Composer GOLD Software Copyright (c) 1985-1994
by Building Systems Design, Inc.
Release 5.30A

ABOR ID: FTCAMP  EQUIP ID: NAT97A  Currency in DOLLARS  CREW ID: NAT99A  UPB ID: UP99EA

| ovey Lake Restoration | QUANTY | UOM | CREW ID | OUTPUT | LABOR | EQUIPMNT | MATERIAL | OTHER | TOTAL COST | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| Real Estate Costs | | | | | 0 | 0 | 0 | 772,000 | 772,000 | |
| Habitat & Feeding Facilities | | | | | | | | | | |
| Mobilization | | | | | | | | | | |
| Bank Stabilization | 1.00 | EA | | 0.00 | 0 | 0 | 0 | 15,000 | 15,000 | 15000 |
| Reforestation' | 1.00 | EA | | 0.00 | 0 | 0 | 0 | 15,000 | 15,000 | 15000 |
| Dredge | 2.00 | LS | | 0.53 | 5,800 | 8,700 | 0 | 0 | 14,500 | 7250.00 |
| Dredge | 2.00 | LS | | 0.53 | 5,800 | 8,700 | 0 | 0 | 14,500 | 7250.00 |
| Dredge | 2.00 | LS | | 0.53 | 5,800 | 8,700 | 0 | 0 | 14,500 | 7250.00 |
| Bull Dozer | 2.00 | LS | | 6.00 | 59 | 304 | 0 | 0 | 363 | 181.50 |
| Vibrating Roller | 2.00 | LS | | 6.00 | 59 | 304 | 0 | 0 | 363 | 181.50 |
| Contingencies | 1.00 | LS | | 6.00 | 0 | 0 | 0 | 195,600 | 195,600 | 195600 |
| Mobilization | | | | | 17,518 | 26,708 | 0 | 225,600 | 269,826 | |
| Dredging | | | | | | ** OVERTIME ** | | | | |
| AUGERHD MUDCAT, 8" DISCHARG E DIA | 6901.70 | HR | M10EL007 | 0.00 | 0 | 301,748 | 0 | 0 | 301,748 | 43.72 |
| AUGERHD MUDCAT, 8" DISCHARG E DIA | 6901.70 | HR | M10EL007 | 0.00 | 0 | 301,748 | 0 | 0 | 301,748 | 43.72 |
| AUGERHD MUDCAT, 8" DISCHARG E DIA | 6901.70 | HR | M10EL007 | 0.00 | 0 | 301,748 | 0 | 0 | 301,748 | 43.72 |
| Outside Laborer | 13818 | HR | X-LABORER | 0.00 | 333,459 | 0 | 0 | 0 | 333,459 | 24.13 |
| Outside Laborer | 13818 | HR | X-LABORER | 0.00 | 333,459 | 0 | 0 | 0 | 333,459 | 24.13 |
| Outside Laborer | 13818 | HR | X-LABORER | 0.00 | 333,459 | 0 | 0 | 0 | 333,459 | 24.13 |
| Outside Equip. Op. Medium | 6907.92 | HR | X-EQOPRMED | 0.00 | 146,811 | 0 | 0 | 0 | 146,811 | 21.25 |
| Outside Equip. Op. Medium | 6907.92 | HR | X-EQOPRMED | 0.00 | 146,811 | 0 | 0 | 0 | 146,811 | 21.25 |
| Outside Equip. Op. Medium | 6907.92 | HR | X-EQOPRMED | 0.00 | 146,811 | 0 | 0 | 0 | 146,811 | 21.25 |
| Dredging | 2487100 | CY | | | 1,440,812 | 905,244 | 0 | 0 | 2,346,056 | 0.94 |
| Geotube Levee Basin 1 | | | | | | | | | | |
| Bulk Site Exc & Shaping, Sm Area | 7200.00 | CY | CODTA | 46.88 | 25,679 | 2,767 | 0 | 0 | 28,446 | 3.95 |
| Small Dozer | | | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Geotubes<br>Material cost is for 45'Circumference Geotubes at 200' long.<br><br>Other cost is for unloading and position into place and other misc costs associated with tube handling. | 36.00 LA | 0.00 | 0 | 0 | 983 | 7,200 | 8,183 | 227.30 |

ABOR ID: FTCAMP EQUIP ID: NAT97A Currency in DOLLARS CREW ID: NAT99A UPB ID: UP99EA

| ovey Lake Restoration | QUANTY | UOM | CREW ID | OUTPUT | LABOR | EQUIPMNT | MATERIAL | OTHER | TOTAL COST | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| Geotube Levee Basin 1 | 36.00 | EA | | | 25,679 | 2,767 | 983 | 7,200 | 36,629 | 1017.46 |
| Geotube Levee Basin 2 | | | | | | | | | | |
| Bulk Site Exc & Shaping, Sm Area | 4200.00 | CY | CODTA | 46.88 | 14,979 | 1,614 | 0 | 0 | 16,593 | 3.95 |
| Small Dozer | | | | | | | | | | |
| Geotubes | 21.00 | EA | | 0.00 | 0 | 0 | 573 | 4,200 | 4,773 | 227.30 |
| Material cost is for 45'Circumference Geotubes at 200' long. | | | | | | | | | | |
| Other cost is for unloading and position into place and other misc costs associated with tube handling. | | | | | | | | | | |
| Geotube Levee Basin 2 | 21.00 | EA | | | 14,979 | 1,614 | 573 | 4,200 | 21,367 | 1017.46 |
| Geotube Levee Basin 3 | | | | | | | | | | |
| Bulk Site Exc & Shaping, Sm Area | 1800.00 | CY | CODTA | 46.88 | 6,420 | 692 | 0 | 0 | 7,111 | 3.95 |
| Small Dozer | | | | | | | | | | |
| Geotubes | 9.00 | EA | | 0.00 | 0 | 0 | 246 | 1,800 | 2,046 | 227.30 |
| Material cost is for 45'Circumference Geotubes at 200' long. | | | | | | | | | | |
| Other cost is for unloading and position into place and other misc costs associated with tube handling. | | | | | | | | | | |
| Geotube Levee Basin 3 | 9.00 | EA | | | 6,420 | 692 | 246 | 1,800 | 9,157 | 1017.46 |
| Geotube Levee Basin 4 | | | | | | | | | | |
| Bulk Site Exc & Shaping, Sm | 2400.00 | CY | CODTA | 46.88 | 8,560 | 922 | 0 | 0 | 9,482 | 3.95 |

Area
Small Dozer

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Geotubes | 12.00 EA | 0.00 | 0 | 0 | 328 | 2,400 | 2,728 | 227.30 |

Material cost is for 45'Circumference Geotubes at 200' long.

Other cost is for unloading and position into place and other misc costs associated with tube handling.

ABOR ID: FTCAMP EQUIP ID: NAT97A Currency in DOLLARS CREW ID: NAT99A UPB ID: UP99EA

| ovey Lake Restoration | QUANTY | UOM | CREW ID | OUTPUT | LABOR | EQUIPMNT | MATERIAL | OTHER | TOTAL COST | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| Geotube Levee Basin 4 | 26.00 | EA | | | 8,560 | 922 | 328 | 2,400 | 12,210 | 469.60 |
| Shape Bank and trench for A-jack | | | | | | | | | | |
| HYD EXCAV, CRWLR, 2.50 CY B KT | 41.00 | HR | H25BA004 | 1.00 | 0 | 2,918 | 0 | 0 | 2,918 | 71.16 |
| Outside Equip. Op. Medium | 41.00 | HR | X-EQOPRMED | 1.00 | 830 | 0 | 0 | 0 | 830 | 20.25 |
| Outside Laborer | 41.00 | HR | X-LABORER | 1.00 | 935 | 0 | 0 | 0 | 935 | 22.81 |
| Shape Bank and trench for A | 4100.00 | CY | | | 1,765 | 2,918 | 0 | 0 | 4,683 | 1.14 |
| A-JACKS | | | | | | | | | | |
| Outside Laborer | 220.80 | HR | X-LABORER | 0.00 | 5,146 | 0 | 0 | 0 | 5,146 | 23.31 |
| Outside Laborer | 220.80 | HR | X-LABORER | 0.00 | 5,036 | 0 | 0 | 0 | 5,036 | 22.81 |
| Outside Laborer | 220.80 | HR | X-LABORER | 0.00 | 5,036 | 0 | 0 | 0 | 5,036 | 22.81 |
| A-jacks | 13800 | EA | | 0.00 | 0 | 0 | 149,247 | 0 | 149,247 | 10.82 |
| A-JACKS | 13800 | EA | | | 15,219 | 0 | 149,247 | 0 | 164,466 | 11.92 |
| Geofabric | | | | | | | | | | |
| Erosion Control,18 Mil Viny l Mat | 10222 | SY | ULABK | 57.50 | 12,253 | 621 | 52,844 | 0 | 65,719 | 6.43 |
| 3 Dimensional, Nylon Geomatrix | | | | | | | | | | |
| Erosion Control, Slope Stak es | 17889 | EA | N/A | 0.00 | 0 | 0 | 5,823 | 0 | 5,823 | 0.33 |
| Required 3' to 5' Intervals | | | | | | | | | | |
| Geofabric | 10222 | SY | | | 12,253 | 621 | 58,667 | 0 | 71,542 | 7.00 |
| Ship A-jacks by barge | | | | | | | | | | |
| From Owensboro, KY to Big Sandy River 439 miles. | | | | | | | | | | |
| TUG BOAT, 150 TO 40O HP | 104.76 | HR | XX0XX004 | 0.00 | 0 | 2,688 | 0 | 0 | 2,688 | 25.66 |
| DREDGE BARGE, 500 TO 800 TO N | 104.76 | HR | XX0XX006 | 0.00 | 0 | 2,308 | 0 | 0 | 2,308 | 22.03 |
| Outside Equip. Op. Heavy | 104.76 | HR | X-EQOPRHVY | 0.00 | 2,907 | 0 | 0 | 0 | 2,907 | 27.75 |
| Outside Laborer | 104.76 | HR | X-LABORER | 0.00 | 2,389 | 0 | 0 | 0 | 2,389 | 22.81 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Ship A-jacks by barge | 523.80 MI | | 5,297 | 4,996 | 0 | 0 | 10,293 | 19.65 |
| Project Management | | | | | | | | |
| Forestry Plan | 1.00 EA | 0.00 | 0 | 0 | 0 | 5,000 | 5,000 | 5000.00 |
| Project Management | | | 0 | 0 | 0 | 5,000 | 5,000 | |

ABOR ID: FTCAMP EQUIP ID: NAT97A Currency in DOLLARS CREW ID: NAT99A UPB ID: UP99EA

| ovey Lake Restoration | QUANTY | UOM | CREW ID | OUTPUT | LABOR | EQUIPMNT | MATERIAL | OTHER | TOTAL COST | UNIT |
|---|---|---|---|---|---|---|---|---|---|---|
| TREES/PLANTS/GROUND COVER | | | | | | | | | | |
| Reforestation | | | | | | | | | | |
| Priority 1 Reforestation<br>Reforest 70% of Priority 1 land aquisition.<br><br>Assume Trees are available from the State Nursery.<br><br>Trees are planted on a 12'x12' or approximately 320 per acre.<br><br>Costs:<br>Bareroot Seedlings are $0.30/tree, or $90.60/acre.<br><br>Labor is $0.20/tree, or $60.40/acre.<br><br>Herbicide treatment is $30.00/acre. | 120.00 | ACR | | 0.00 | 7,248 | 0 | 16,632 | 3,600 | 27,480 | 229.00 |
| Reforestation | | | | | 7,248 | 0 | 16,632 | 3,600 | 27,480 | |
| TREES/PLANTS/GROUND COVER | | | | | 7,248 | 0 | 16,632 | 3,600 | 27,480 | |
| Habitat & Feeding Facilitie | | | | | 1,555,750 | 946,482 | 226,676 | 249,800 | 2,978,707 | |
| Planning, Engineering & Des | | | | | 0 | 0 | 0 | 427,000 | 427,000 | |
| Engineering During Construc | | | | | 0 | 0 | 0 | 118,800 | 118,800 | |
| Construction Management | | | | | 0 | 0 | 0 | 296,000 | 296,000 | |
| Hovey Lake Restoration | | | | | 1,555,750 | 946,482 | 226,676 | 1,863,600 | 4,592,507 | |
| Indiana | | | | | 1,555,750 | 946,482 | 226,676 | 1,863,600 | 4,592,507 | |

| | | | | | |
|---|---|---|---|---|---|
| Hovey Lake Restoration | 1,355,750 | 940,482 | 220,076 | 1,863,000 | 4,392,307 |

ABOR ID: FTCAMP EQUIP ID: NAT97A Currency in DOLLARS CREW ID: NAT99A UPB ID: UP99EA

| | | | QUANTY | UOM | CONTRACT | CONTINGN | TOTAL COST | UNIT |
|---|---|---|---|---|---|---|---|---|
| 02 | Indiana | | | | | | | |
| 02-01 | Hovey Lake Restoration | | | | | | | |
| 02-01{ | 0100 | Lands and Damages | | | 772,000 | 188,000 | 960,000 | |
| 02-01{ | 0603 | Fish & Wildlife Facilities and | | | 3,718,048 | 929,512 | 4,647,560 | |
| 02-01{ | 3000 | Planning, Engineering & Design | | | 545,800 | 109,160 | 654,960 | |
| 02-01{ | 3100 | Construction Management | | | 296,000 | 59,200 | 355,200 | |
| | TOTAL | Hovey Lake Restoration | | | 5,331,848 | 1,285,872 | 6,617,720 | |
| | TOTAL | Indiana | | | 5,331,848 | 1,285,872 | 6,617,720 | |
| | TOTAL | Hovey Lake Restoration | | | 5,331,848 | 1,285,872 | 6,617,720 | |

ABOR ID: FTCAMP EQUIP ID: NAT97A Currency in DOLLARS CREW ID: NAT99A UPB ID: UP99EA

| | | QUANTY | UOM | CONTRACT | CONTINGN | TOTAL COST | UNIT |
|---|---|---|---|---|---|---|---|
| 02 | Indiana | | | | | | |
| 02-01 | Hovey Lake Restoration | | | | | | |
| 02-01{ 0100 | Lands and Damages | | | | | | |
| 02-01{ 010001 | Real Estate Costs | | | 772,000 | 188,000 | 960,000 | |
| | TOTAL Lands and Damages | | | 772,000 | 188,000 | 960,000 | |
| 02-01{ 0603 | Fish & Wildlife Facilities and | | | | | | |
| 02-01{ 060373 | Habitat & Feeding Facilities | | | | | | |
| 02-01{ 060373}1 | Mobilization | | | 336,799 | 84,200 | 420,999 | |
| 02-01{ 060373}2 | Dredging | 2487100 | CY | 2,928,367 | 732,092 | 3,660,459 | 1.47 |
| 02-01{ 060373}3 | Geotube Levee Basin 1 | 36.00 | EA | 45,720 | 11,430 | 57,150 | 1587.50 |
| 02-01{ 060373}4 | Geotube Levee Basin 2 | 21.00 | EA | 26,670 | 6,668 | 33,338 | 1587.50 |
| 02-01{ 060373}5 | Geotube Levee Basin 3 | 9.00 | EA | 11,430 | 2,858 | 14,288 | 1587.50 |
| 02-01{ 060373}6 | Geotube Levee Basin 4 | 26.00 | EA | 15,240 | 3,810 | 19,050 | 732.69 |
| 02-01{ 060373}7 | Shape Bank and trench for A-jack | 4100.00 | CY | 5,846 | 1,461 | 7,307 | 1.78 |
| 02-01{ 060373}8 | A-JACKS | 13800 | EA | 205,287 | 51,322 | 256,609 | 18.59 |
| 02-01{ 060373}9 | Geofabric | 10222 | SY | 89,299 | 22,325 | 111,624 | 10.92 |
| 02-01{ 060373}A | Ship A-jacks by barge | 523.80 | MI | 12,848 | 3,212 | 16,060 | 30.66 |
| 02-01{ 060373}B | Project Management | | | 6,241 | 1,560 | 7,801 | |
| 02-01{ 060373}C | TREES/PLANTS/GROUND COVER | | | 34,301 | 8,575 | 42,876 | |
| | TOTAL Habitat & Feeding Facilities | | | 3,718,048 | 929,512 | 4,647,560 | |
| | TOTAL Fish & Wildlife Facilities and | | | 3,718,048 | 929,512 | 4,647,560 | |
| 02-01{ 3000 | Planning, Engineering & Design | | | | | | |
| 02-01{ 300001 | Planning, Engineering & Design | | | 427,000 | 85,400 | 512,400 | |
| 02-01{ 300002 | Engineering During Construction | | | 118,800 | 23,760 | 142,560 | |
| | TOTAL Planning, Engineering & Design | | | 545,800 | 109,160 | 654,960 | |

| | | | | |
|---|---|---|---|---|
| 02-01{ 3100 | Construction Management | | | |
| 02-01{ 310001 | Construction Management | 296,000 | 59,200 | 355,200 |
| | TOTAL Construction Management | 296,000 | 59,200 | 355,200 |
| | TOTAL Hovey Lake Restoration | 5,331,848 | 1,285,872 | 6,617,720 |

| | QUANTY | UOM | CONTRACT | CONTINGN | TOTAL COST | UNIT |
|---|---|---|---|---|---|---|
| TOTAL Indiana | | | 5,331,848 | 1,285,872 | 6,617,720 | |
| TOTAL Hovey Lake Restoration | | | 5,331,848 | 1,285,872 | 6,617,720 | |

ABOR ID: FTCAMP EQUIP ID: NAT97A Currency in DOLLARS CREW ID: NAT99A UPB ID: UP99EA

---

o errors detected...

* * * END OF ERROR REPORT * * *

ABOR ID: FTCAMP EQUIP ID: NAT97A Currency in DOLLARS CREW ID: NAT99A UPB ID: UP99EA

---

SUMMARY REPORTS SUMMARY PAGE



DETAILED ESTIMATE DETAIL PAGE



o Backup Reports...

* * * END TABLE OF CONTENTS * * *

EXHIBIT H-2

July 2000

## PRELIMINARY FINAL REPORT

# INCREMENTAL ANALYSIS OF THE HOVEY LAKE RESTORATION PROJECT, INDIANA

Submitted to

**U.S. Army Corps of Engineer**
**Louisville District**
Louisville, Kentucky

Submitted by


**Federal Programs Division**
Baton Rouge, Louisiana

July 2000

**PRELIMINARY FINAL REPORT**

Contract No. DACW27-99-D-0019
Delivery Order No. 0004
GEC Project No. 22321304

# INCREMENTAL ANALYSIS OF THE HOVEY LAKE RESTORATION PROJECT, INDIANA

Submitted to

**U.S. Army Corps of Engineers**
**Louisville District**
Louisville, Kentucky

Submitted by

**G.E.C., Inc.**
Baton Rouge, Louisiana

Engineering ? Economics ? Transportation Technology ? Social Analysis ? Environmental Planning

P.O. Box 84010 ? Baton Rouge, Louisiana 70884-4010 ? (225) 612-3000 ? Fax (225) 612-3016
9357 Interline Avenue ? Baton Rouge, Louisiana 70809-1910

## TABLE OF CONTENTS

## LIST OF TABLES

## 1.0 INTRODUCTION, PURPOSE AND NEED

This work presents an incremental analysis of the costs and benefits of the Ohio River ecosystem restoration project IN10 – Hovey Lake Restoration, a feasibility level study associated with a proposed ecosystem restoration program for the Ohio River. This study serves as an example incremental analysis for various ecosystem components considered as part of the program. The Corps has been involved in a large ecosystem restoration study of the Ohio River extending from Cairo, Illinois, to Pittsburgh, Pennsylvania. The Louisville, Huntington, and Pittsburgh districts are currently working with other Federal agencies and six states to develop an array of ecosystem restoration projects.

The proposed Hovey Lake Restoration Project is located in southern Indiana at Hovey Lake Fish and Wildlife Management Area (FWA), which is managed by the Indiana Department of Natural Resources (IDNR). The Hovey Lake FWA encompasses lands owned by the Federal Government and the State of Indiana. The proposed Hovey Lake Restoration Project includes restoration efforts on the FWA proper as well as on adjoining private lands.

Hovey Lake is located in rural Posey County, Indiana, approximately seven miles south of Mt. Vernon, Indiana. The project site is located in the J. T. Myers Pool near Ohio River Miles (ORM) 835-841. Hovey Lake is within the jurisdiction of the Louisville District, U.S. Army Corps of Engineers (USACE).

Hovey Lake is one of the few large Ohio River oxbow lakes remaining in the State of Indiana. Oxbow lakes, which are cut off from the river except during periods of high river stage, are important spawning, nursery, and feeding areas for riverine fishes. Oxbow lakes also provide important habitat for migratory waterfowl, wading birds, and other wildlife. Oxbow lakes, due to their cut-off nature and location within river floodplains, slowly fill in with sediments. New oxbows were formed as older oxbows gradually filled with sediment and became terrestrial habitat, Consequently, oxbow habitats were typically always present within the river system. With the establishment of the navigation system on the Ohio River the natural process of oxbow lake formation has ceased. New Ohio River oxbow lakes are no longer being formed. Consequently, the remaining oxbow lakes have become significant habitats that the State of Indiana wishes to protect and restore as functioning aquatic ecosystems.

The specific goals of the Hovey Lake Restoration Project include two distinct elements to prolong the functional life of the aquatic ecosystem at Hovey Lake and to improve the fish and wildlife habitat within the project area. The principal elements of the Hovey Lake Restoration Project are the restoration of oxbow habitat and erosion/sediment control of the Ohio River bank. Three proposed alternatives, presented below, were designed to meet these principal elements.

## 2.0 PROPOSED ALTERNATIVES

### 2.1 No-Action

Hovey Lake is an aquatic ecosystem valuable to a number of fish and wildlife species. Under the No-Action Alternative no efforts will be implemented to stop the loss of this ecosystem. Deposition of sediments into Hovey Lake during high river stages will continue to occur at the present rates.

Soils in agricultural lands north of the lake will continue to be washed into Hovey Lake during overbank flooding of the river. The lake and its surrounding wetlands will continue to receive large amounts of sediment during flood events, and over time these aquatic habitats will fill in and become terrestrial habitat.

## 2.2 Alternative 1. Restoration of Oxbow Habitat

The backwater habitat within the Hovey Lake oxbow serves as reproductive, feeding, nursery, high water refuge, seasonal migration, and overwintering habitat for many fish species, including paddlefish. Maximum depth of the lake has decreased by at least three feet since 1976 when the J. T. Myers Locks and Dam were completed. The aquatic habitat at Hovey Lake will be restored by dredging 50 percent of the 300-acre open basin to an average depth of 20 feet at normal pool.

Maintenance dredging of Hovey Lake will be required to provide deep-water habitat and to extend the life of the historic oxbow. An estimated 2,490,000 cubic yards of silty-clay material would be dredged to restore depths of 7 to 20 feet. Three small auger head dredges would be used, and the material would be pumped directly to the disposal sites. Approximately 145 acres of the 300-acre open basin area of Hovey Lake will be dredged. The outer limits of dredging would occur approximately 100 yards inside the open basin area. Depths at this distance range from six to seven feet. Dredging would begin at this location and would descend at a 10:1 slope to depths of 20 feet. Four dredge disposal sites adjacent to the lake have been identified. Small geotube levees, five feet high, would be constructed at the designated disposal sites for dewatering. All dredge disposal sites were selected from USGS topographic maps and site visits. Detailed survey data would be required to better determine the limits and volumes of the disposal areas. The disposal areas are located on property owned by the State of Indiana. The disposal areas will be graded to a near even height and reseeded with native species following dewatering.

## 2.3 Erosion/Sediment Control and Ohio River Bank Stabilization

Hovey Lake receives sediment deposition during Ohio River flood events. When the Ohio River leaves its banks, it floods across the private agricultural land north of Hovey Lake and into Hovey Lake. The flood waters carry sediments from: a) floodplain scour in the farmed areas north of the lake, b) riverborne sediments and c) heavy bank erosion along the Ohio River banks north of the lake. The flood-induced sedimentation appears to have increased since 1995 after erosion control structures were installed on Slim Island and tree logging occurred on the land north of the lake. These events appear to have changed the direction of the flood current and increased sediment loading in Hovey Lake. Restoration activities to address this problem have been identified in the two alternatives presented below.

**2.3.1 Alternative 2. Shoreline Stabilization.** The Ohio River shoreline north of the lake is unstable and exhibits heavy bank erosion. River currents, in conjunction with barge traffic, are actively eroding the Ohio River bank. Average channel velocities are three feet per second. The erosion has produced steep banks with little or no vegetation. A biostabilization approach to bank stabilization of the approximately 0.9 mile of shoreline is preferred to simple bank hardening with rip-rap.

A-jacks® by Armortec, or similar structures, will be used for structural bank reinforcement by stabilizing the toe of the eroding slope. A-jacks® structures are concrete erosion control units designed to interlock with each other. Each unit resembles toy jacks, having six legs with each leg extending about 12 inches from the center of the unit. Each unit weighs 78 pounds and is small enough to be assembled and placed by hand.

Interconnecting rows of A-jacks® units would be placed into the riverbed a minimum of 1.5 feet deep along the toe trench. Two rows would be used as a base, with a single row on top, forming a highly porous interlocking matrix. The voids created by the interlocking A-jacks® will be filled with soil to establish a foundation to support woody vegetation above the normal pool elevation of the Ohio River. Backfill material for the voids would be taken from onsite. A geotextile fabric would be used in conjunction with an aggregate base to reduce the removal of fine soils while root systems develop. A geotextile fabric is a permeable erosion control fabric used with foundation, soil, rock or any other geotechnical engineering material as an integral part of a project or structure. Geotextiles are made in woven or non-woven configurations from yarns, fibers, or slit films and are used for drainage, filtration, stabilization, and soil reinforcement applications.

Light mast-producing trees such as black willow, cottonwood, and sycamore will reseed/regenerate naturally in the structure voids. If necessary, additional cuttings and rooted stock will be placed behind the A-jacks® matrix along the earthen berm.

**2.3.2 Alternative 3. Reforestation.** Sedimentation reduction in Hovey Lake will be augmented via flood desynchronization. Reforestation of a large parcel near the Ohio River north of the lake will reduce erosion and slow floodwaters, allowing the sediment load to be dropped north of Hovey Lake rather than in Hovey Lake.

Approximately 120 acres of floodplain will be reforested with native mast-producing bottomland hardwood trees. Bare root seedlings, obtained from a State of Indiana nursery, will be planted in a similar manner to ongoing reforestation efforts being conducted in the Hovey Lake area. The forested area will aid reduction of drift, trash, and sediments from Ohio River floodwaters entering into Hovey Lake. Historically, sediment and trash laden floodwaters have accelerated the filling of Hovey Lake. The reforestation will aid in flood desynchronization and prolong the life and viability of Hovey Lake.

Soil types, hydrology, and terrain position will be the primary factors considered when selecting the tree species to be planted, and a detailed planting design will be developed to insure a successful planting. Typical bottomland species to be planted in the floodplain include pin oak (*Quercus palustris*), swamp chestnut oak (*Quercus michauxii*), swamp white oak (*Quercus bicolor*), pecan (*Carya illinoensis*), and shagbark hickory (*Carya ovata*). Aggressive light mast producing species, such as silver maple (*Acer saccharinum*), green ash (*Fraxinus pennsylvanica*), sycamore (*Platanus occidentalis*), and/or willows (*Salix* spp.), are expected to regenerate naturally.

## 3.0 COST ANALYSIS

### 3.1 Introduction

This section presents the findings of a cost effectiveness and incremental cost analysis of no-action, the three alternatives, and various combinations of the alternatives under consideration. These cost analyses are not intended to determine the best alternative or combination of alternatives, but rather, are intended to provide decision-makers with a comparison of alternatives that produce different levels of environmental outputs and to assist in selecting the alternative that best satisfies project objectives. The analyses are intended to improve the quality of decision-making when considering alternative plans.

The cost effectiveness and incremental cost analysis was conducted in accordance with guidelines contained in EC 1105-2-206, entitled *Project Modification for Improvement of the Environment*, which is the same guidance as EC 1105-2-210, dated June 1, 1995, entitled *Ecosystem Restoration in the Civil Works Program*, EC 1105-2-214, dated October 3, 1998, entitled *Project Modifications for Improvement and Aquatic Ecosystem Restoration*, and Institute for Water Resources report *Evaluation of Environmental Investments Procedures Manual Interim: Cost Effectiveness and Incremental Cost Analyses*, dated May 1995 (IWR Report 95-R-1).

The Institute for Water Resources (IWR) has developed IWR-PLAN Decision Support Software to assist with the formulation and comparison of alternative plans of environmental restoration projects. IWR-PLAN assists in plan formulation by combining solutions to planning problems and calculating the additive effects of each alternative or combination of alternatives. When developing a combination of alternatives, IWR-PLAN includes each alternative in the combination, assigning either an action or no-action status to each. For instance, when evaluating a project with three alternatives, the IWR-PLAN total output for implementing Alternative 1 is calculated as the output associated with implementing Alternative 1 plus the negative output (if any) associated with no-action under alternatives 2 and 3.

IWR-PLAN assists in plan formulation and comparison of alternatives by conducting cost effectiveness and incremental cost analyses. IWR-PLAN was used in conducting the cost effectiveness and incremental cost analyses for the Hovey Lake Restoration Project.

As the name indicates, cost effectiveness analysis is a method for comparing alternative plans that produce environmental outputs and for determining which plan can produce the largest quantity of output for a given cost, or produce the same or greater quantity of output for less cost. Cost effectiveness analysis determines if: (1) the same environmental output level could be produced by another plan at less cost; (2) a larger environmental output level could be produced at the same cost; or (3) a larger environmental output level could be produced at less cost. For instance, if two alternatives produce the same amount of environmental outputs, the alternative with the lowest cost is considered cost effective. Likewise, if the costs of two alternatives are equal, but one produces more outputs than the other, the one producing the higher level of outputs would be the cost effective alternative. Also, an alternative that costs less and produces higher levels of output is considered to be cost effective compared to higher cost alternatives producing lower levels of output.

Incremental cost analysis builds on the findings of the cost effectiveness analysis. This is accomplished by comparing the increase in costs to the increase in outputs associated with advancing from one output level (one cost effective alternative) to the next higher output level (another cost effective alternative).

## 3.2 Cost Estimates of Alternatives

To conduct cost effectiveness and incremental cost analyses, the total cost of implementing each alternative must be estimated and stated on an average annual basis. The preliminary cost estimates developed for each alternative were obtained from the Microcomputer Aided Cost Estimating System (MCACES) cost estimates developed as part of the feasibility report and additional cost elements (real estate, plans and specifications, and supervision and administration during construction).

**3.2.1. Alternative 1. Restoration of Oxbow Habitat.** The total estimated cost associated with implementing Alternative 1 is $3,979,244 (Table 3-1). Activities included in these costs are equipment mobilization, dredging approximately 2,490,000 cubic yards of material from a 145-acre area of the 300-acre open basin of the lake, and construction of geotube levees around the four disposal sites adjacent to the lake. Also included in the costs are contingencies, real estate costs, plans and specifications, supervision and administration during construction, and interest during construction. Interest during construction is based on the federal discount rate of 6.625 percent and a construction schedule of 529 days. The schedule includes 307 days for dredging activities, 42 days for levee construction, 168 days for dewatering, and 12 days for mobilization.

**Table 3-1. Hovey Lake Restoration Project, Alternative 1, Restoration of Oxbow Habitat, Cost Estimate**

| Item | Costs |
|---|---|
| Dredging Costs | |
| Mobilization | $44,226 |
| Dredging | $2,346,056 |
| Geotube Levee Basin 1 | $36,582 |
| Geotube Levee Basin 2 | $21,339 |
| Geotube Levee Basin 3 | $9,145 |
| Geotube Levee Basin 4 | $12,194 |
| Contingencies | $174,573 |
| Real Estate Costs | $670,000 |
| Plans and Specifications | $240,975 |
| S & A During Construction | $241,868 |
| Cost Subtotal | $3,796,958 |
| Interest During Construction | $182,286 |
| Gross Investment | $3,979,244 |

Sources: Ohio River Mainstream Ecosystem Restoration Project – Feasibility Report; Louisville District, USACE; and G.E.C., Inc.

**3.2.2. Alternative 2. Shoreline Stabilization.** The total estimated cost of Alternative 2 is $376,257 (Table 3-2). Activities included in these costs are equipment mobilization, bank and trench shaping, and purchase, shipment and placement of A-jacks® and geofabric. Also included in the

costs are contingencies, real estate costs, plans and specifications, supervision and administration during construction, and interest during construction, based on the federal discount rate of 6.625 percent and a construction schedule of 60 days.

**Table 3-2. Hovey Lake Restoration Project, Alternative 2, Shoreline Stabilization, Cost Estimate**

| Item | Costs |
|---|---|
| Stabilization Costs | |
| Mobilization | $15,000 |
| Shape Bank and Trench for A-Jacks | $4,683 |
| A-Jacks | $157,359 |
| Geofabric | $68,748 |
| Ship A-Jacks By Barge | $10,293 |
| Contingencies | $18,093 |
| Real Estate Costs | $50,000 |
| Plans and Specifications | $24,975 |
| S & A During Construction | $25,068 |
| Cost Subtotal | $374,219 |
| Interest During Construction | $2,038 |
| Gross Investment | $376,257 |

Sources: Ohio River Mainstream Ecosystem Restoration Project – Feasibility Report; Louisville District, USACE; and G.E.C., Inc.

**3.2.3. Alternative 3. Reforestation.** The total estimated cost of implementing Alternative 3 is $353,217 (Table 3-3). Activities included in these costs are equipment mobilization and reforestation. Other included costs are contingencies, real estate costs, plans and specifications, supervision and administration during construction, and interest during construction. Interest during construction is based on the federal discount rate of 6.625 percent and a reforestation schedule of 15 days.

## 3.3 Average Annual Cost

Table 3-4 presents a summary of the cost estimates for the three alternatives. The average annual cost of implementing each alternative, assuming a 50-year project life and a federal discount rate of 6.625 percent, is also presented. The average annual cost is the annual amount required to amortize the present value of project costs over the life of the project. It is equivalent to the annual payment needed to finance the project over 50 years at 6.625 percent interest.

The average annual cost for Alternative 1, Restoration of Oxbow Habitat, is $283,082. This includes an average annual cost of gross investment of $274,741 and average annual operation and maintenance costs of $8,341. The operation and maintenance costs are based on costs of $500,000 expected to be incurred in years 25 and 50 of the project. These costs are discounted to their net present value then amortized over the life of the project.

**Table 3-3. Hovey Lake Restoration Project, Alternative 3, Reforestation, Cost Estimate**

| Item | Costs |
|---|---|
| Reforestation Costs | |
| Mobilization | $15,000 |
| Reforestation | $26,688 |
| Contingencies | $2,934 |
| Real Estate Costs | $300,000 |
| Plans and Specifications | $4,050 |
| S & A During Construction | $4,065 |
| Cost Subtotal | $352,737 |
| Interest During Construction | $480 |
| Gross Investment | $353,217 |

Sources. Ohio River Mainstream Ecosystem Restoration Project – Feasibility Report; Louisville District, USACE; and G.E.C., Inc.

**Table 3-4. Hovey Lake Restoration Project, Summary of Construction and O & M Costs for Each Alternative**

| Item | Alternative 1 | Alternative 2 | Alternative 3 |
|---|---|---|---|
| Gross Investment | $3,979,244 | $376,257 | $353,217 |
| Annualized Gross Investment Cost | $274,741 | $25,978 | $24,387 |
| Annualized O&M Costs | $8,341 | $8,885 | $286 |
| Total Annualized Costs | $283,082 | $34,863 | $24,673 |

Sources: Ohio River Mainstream Ecosystem Restoration Project - Feasibility Report; Louisville District, USACE; and G.E.C., Inc.

The average annual cost for Alternative 2, Bank Stabilization, is $34,863. This includes an average annual cost of gross investment of $25,978 and average annual operation and maintenance costs of $8,885. The operation and maintenance costs are based on costs of $120,600 expected to be incurred every 10 years during the life of the project. These costs are discounted to their net present value then amortized over the life of the project.

The average annual cost for Alternative 3, Reforestation, is $24,673. This includes an average annual cost of gross investment of $24,387 and average annual operation and maintenance costs of $286. The operation and maintenance costs are based on costs of $1,000 expected to be incurred in each of the first five years of the project for reforestation monitoring. These costs are discounted to their net present value then amortized over the life of the project.

## 3.4 Environmental Benefits

Environmental impacts associated with no-action and each alternative were measured in habitat acres. Because of resource and time constraints, field surveys could not be conducted to define the impact of each alternative. Therefore, environmental impacts were estimated using information provided in the feasibility report. Extensive field surveys would be required to more accurately quantify the environmental impacts of each alternative.

**3.4.1. Alternative 1. Restoration of Oxbow Habitat.** The dredging of 145 acres of open basin in Hovey Lake will increase the depth of the basin up to 20 feet. The average depth of the basin, six to seven feet, is slowly decreasing from deposition of sediments during overbank flooding of the Ohio River. The maximum depth of the lake has decreased by at least three feet since 1976. Proposed dredging activities will help prolong the life of the Hovey Lake aquatic ecosystem, which provides quality habitat for a variety of fishes, benthic organisms, birds (specifically waterfowl, shorebirds, and wading birds), reptiles, amphibians, and mammals.

The paddlefish (*Polyodon spathula*) is one species that particularly relies on this unique habitat as a nursery for its young. Larvae and juvenile paddlefish will migrate from spawning areas into the oxbow during flood events to feed on the abundant supply of zooplankton, the predominant food for this species. The majority of the juveniles will remain in the oxbow until they have reached maturity, at which time the adult paddlefish, as well as some juveniles, will emigrate to the river channel during spring flood events and continue on to breeding grounds to spawn (Hoxmeier, 1997). Through the dredging activities, the paddlefish will be able to continue using Hovey Lake as a nursery for its young. The deepening of the lake will also help to maintain a healthy and diverse population of deep-water benthic organisms used by a variety of aquatic species for food.

As the lake is dredged, the dredged material will be placed on four adjacent sites. Once these disposal areas are dewatered and graded, the areas will be returned to agricultural production. Currently, these fields are primarily used by Hovey Lake FWA as part of their ongoing waterfowl management program; they will be returned to that use once the site is dewatered and graded.

In summary, if this alternative is implemented, 145 acres of aquatic habitat will be created at the beginning of the project by increasing the volume of the lake by about 1,550 acre-feet of water. There will be no direct loss of habitat for no-action under this alternative. Therefore, the average annual net impact of this alternative alone will be the creation of 145 average annual acres of beneficial habitat. This is the only alternative evaluated that will create aquatic habitat; since all other alternatives only prevent the additional loss of aquatic habitat. Table 3-5 presents the acres of habitat created by Alternative 1, habitat lost if no action is taken, and the net impact of the alternative for each year of the project. The average annual impacts of the alternative are also presented. Although there will be no loss of habitat if no action is taken on this alternative, without adequate sediment control (no-action under alternatives 2 and 3), 140 of the 145 acres created under this alternative will be lost by the end of the project due to sedimentation. These losses will be addressed and accounted for below under the discussion of the impacts of no-action associated with alternatives 2 and 3.

**Table 3-5. Annual Benefits Associated With Alternative 1, Restoration of Oxbow Habitat, Hovey Lake Restoration Project**

| Project | Action | No-Action | Total |
|---|---|---|---|
| Year | Acres Created | Acres Lost | Net Acres |
| 1 | 145.0 | 0 | 145.0 |
| 2 | 145.0 | 0 | 145.0 |
| 3 | 145.0 | 0 | 145.0 |
| 4 | 145.0 | 0 | 145.0 |
| 5 | 145.0 | 0 | 145.0 |
| 6 | 145.0 | 0 | 145.0 |
| 7 | 145.0 | 0 | 145.0 |
| 8 | 145.0 | 0 | 145.0 |
| 9 | 145.0 | 0 | 145.0 |
| 10 | 145.0 | 0 | 145.0 |
| 11 | 145.0 | 0 | 145.0 |
| 12 | 145.0 | 0 | 145.0 |
| 13 | 145.0 | 0 | 145.0 |
| 14 | 145.0 | 0 | 145.0 |
| 15 | 145.0 | 0 | 145.0 |
| 16 | 145.0 | 0 | 145.0 |
| 17 | 145.0 | 0 | 145.0 |
| 18 | 145.0 | 0 | 145.0 |
| 19 | 145.0 | 0 | 145.0 |
| 20 | 145.0 | 0 | 145.0 |
| 21 | 145.0 | 0 | 145.0 |
| 22 | 145.0 | 0 | 145.0 |
| 23 | 145.0 | 0 | 145.0 |
| 24 | 145.0 | 0 | 145.0 |
| 25 | 145.0 | 0 | 145.0 |
| 26 | 145.0 | 0 | 145.0 |
| 27 | 145.0 | 0 | 145.0 |
| 28 | 145.0 | 0 | 145.0 |
| 29 | 145.0 | 0 | 145.0 |
| 30 | 145.0 | 0 | 145.0 |
| 31 | 145.0 | 0 | 145.0 |
| 32 | 145.0 | 0 | 145.0 |
| 33 | 145.0 | 0 | 145.0 |
| 34 | 145.0 | 0 | 145.0 |
| 35 | 145.0 | 0 | 145.0 |
| 36 | 145.0 | 0 | 145.0 |
| 37 | 145.0 | 0 | 145.0 |
| 38 | 145.0 | 0 | 145.0 |
| 39 | 145.0 | 0 | 145.0 |
| 40 | 145.0 | 0 | 145.0 |
| 41 | 145.0 | 0 | 145.0 |
| 42 | 145.0 | 0 | 145.0 |
| 43 | 145.0 | 0 | 145.0 |
| 44 | 145.0 | 0 | 145.0 |
| 45 | 145.0 | 0 | 145.0 |
| 46 | 145.0 | 0 | 145.0 |
| 47 | 145.0 | 0 | 145.0 |
| 48 | 145.0 | 0 | 145.0 |
| 49 | 145.0 | 0 | 145.0 |
| 50 | 145.0 | 0 | 145.0 |
| Cumulative Total | 7,250.0 | 0.0 | 7,250.0 |
| Average Annual | 145.0 | 0.0 | 145.0 |

Source: GEC, Inc.

**3.4.2 Erosion/Sediment Control and Ohio River Bank Stabilization.** Sediment deposition in Hovey Lake and surrounding wetlands during Ohio River flood events reduces water quality and degrades/destroys existing aquatic and wetland habitats. Floodwater sediments originate from floodplain scour of farmed areas north of the lake, riverborne sediments, and heavy bank erosion along the Ohio River bank north of the lake.

Since 1976, the maximum depth of the lake has decreased by three feet due to sedimentation. Sedimentation in the lake appears to have increased since 1995 after erosion control structures were installed on Slim Island and tree logging occurred on the land north of the lake. If no action is taken, sediment in an excess of three feet would be deposited in the lake and adjacent wetlands every 25 years, resulting in excess of six feet being deposited over the 50-year life of the project. For the purpose of this analysis, it was assumed that over the life of the project, average flood events and sedimentation rates will prevail. Furthermore, sediment deposition in the lake and wetlands was assumed to occur at a constant rate over the life of the project. Since sediment rates may accelerate as sediment builds up in the lake and wetlands, this analysis presents a conservative estimate of the amount of sediment that would be dropped in the lake and wetlands.

Two alternatives were developed to reduce erosion and sediment. Alternative 2, Shoreline Stabilization, includes stabilization of 0.9 miles of shoreline on the Ohio River bank north of Hovey Lake. Alternative 3, Reforestation, includes reforestation of 120 acres adjacent to the Ohio River. The reforestation would result in the creation of 120 acres of terrestrial/riparian habitat and protect aquatic and wetland resources by reducing the amount of sediment deposited in the lake and surrounding wetlands. If these two alternatives are implemented, most, but not all, of the sediment would be dropped in the reforested areas north of the lake. It is assumed that over the life of the project, five of the six feet of sediment estimated to be dropped in the lake would actually be dropped north of the lake, greatly extending the life of the lake. These alternatives will prevent approximately five feet of sediment from settling over the 300-acre open basin of the lake, protecting a total volume of 1,500 acre-feet of water over the 50-year life of the project, or an average of 750 acre-feet a year. These two alternatives alone protect only half the volume of aquatic habitat as Alternative 1, Restoration of Oxbow Habitat. Therefore, the beneficial habitat acreage protected by these alternatives is 72.5 acres of aquatic habitat.

In addition to protecting aquatic habitat, these alternatives will protect approximately 347 acres of wetland habitat over the 50-year project life. If these alternatives are not implemented, sediment from Ohio River flood events will continue to drop in wetlands to the north and east of the lake, eventually destroying the wetlands. These alternatives would prevent most of this sediment from dropping in the lake and wetlands and thereby extend the life of those wetlands.

**3.4.2.1. Alternative 2. Shoreline Stabilization.** Alternative 2 consists of stabilizing approximately 0.9 mile of the Ohio River shoreline north of Hovey Lake using “A-jacks®” or similar structures. These structures will be placed along the bank of the Ohio River in an interlocking pattern to form a reinforcing foundation at the base of the eroded bank. Soil will be placed to create a foundation in which woody vegetation can be established above the normal pool elevation of the Ohio River through natural or artificial regeneration. This vegetative buffer will strengthen the eroding bank, thereby decreasing the degradation of the bank. The stabilization of the bank will aid in decreasing the amount of sediment entering the Ohio River and being deposited in Hovey Lake during flood events, as well as provide habitat for a variety of terrestrial and aquatic species. The

reduction of sediment in the river will have a positive impact on a variety of aquatic species present in the river, especially mussel populations.

Shoreline stabilization will benefit Hovey Lake water quality and protect surrounding wetlands by reducing sediment from erosion along the Ohio River and by protecting existing and proposed reforested areas in the vicinity. This alternative directly reduces the sediment load by reducing bank erosion. However, the greatest environmental benefits of this alternative will be generated by protecting existing and proposed reforested areas to the south of the bank stabilization area. It was assumed that without stabilization, the river bank will continue to erode to the point that the river would eventually claim 50 percent (60 acres) of the proposed reforested area by the end of the project life.

Table 3-6 presents the acres of habitat created/protected by Alternative 2, habitat lost if no action is taken, and the net impact of the alternative for each year of the project. The average annual impacts of the alternative are also presented. Bottomland hardwood acres that would have been lost would increase from 0 acres in Year 1 of the project to 60 acres by Year 50 of the project. Implementing Alternative 2 will prevent these acres from being lost to erosion. Therefore, the environmental benefits of this alternative include preventing the loss of bottomland hardwood habitat. The number of acres protected would increase from 0 acres at the beginning of the project to 1.2 acres per year over the life of the project, to the point of preventing the loss of 60 acres by the end of the project. This results in the protection of 29.4 acres on an average annual basis.

Protecting the bottomland hardwoods from loss by erosion also results in a corresponding protection of wetland and aquatic habitat acreage. Wetland habitat protected by Alternative 2 will increase from 1.7 acres at the beginning of the project to 86.8 acres at the end of the project, for an average annual quantity of 44.2 acres. Aquatic acres protected by this alternative will increase from 0.7 acres to 35 acres by the end of the project, for an average annual 17.9 acres. This alternative results in the protection of a total of 91.5 acres on an average annual basis. However, these benefits will be realized only if Alternative 2 is implemented in conjunction with Alternative 3, Reforestation. Without the reforestation of 120 acres of agricultural lands adjacent to the Ohio River, shoreline stabilization will not have a significant impact on improving the Hovey Lake ecosystem.

If Alternative 2 is not implemented (no-action), the Ohio River will continue to erode the river banks, and a portion of the 120 acres of the proposed reforested lands north of the lake will be lost to the river. The loss of these bottomland hardwoods will result in the corresponding loss of 1.7 acres of wetland habitat at the beginning of the project, increasing to 86.8 acres at the end of the project, for an average annual loss of 44.2 acres. In addition, 0.7 acres of aquatic habitat will be lost at the beginning of the project, increasing to 35 acres by the end of the project, for an average annual loss of 17.9 acres. No-action under this alternative will result in the loss of a total of 62.1 acres on an average annual basis. In summary, the net benefits of Alternative 2 are the protection of 29.4 average annual acres of habitat, calculated as the acres protected by this alternative (91.5 acres), adjusted for acres lost under no-action (62.1 acres).

**3.4.2.2. Alternative 3. Reforestation.** Alternative 3 consists of reforestation of 120 acres of agricultural land adjacent to the Ohio River at the point where bank stabilization is proposed. The reforestation would improve the stability of the riverbanks and provide structure for decreasing the velocity of the floodwaters as it tops the banks and flows towards Hovey Lake. By slowing the

## Table 3-6. Annual Benefits Associated With Alternative 2, Shoreline Stabilization, Hovey Lake Restoration Project

| | Action | | | | No-Action | | | Total |
|---|---|---|---|---|---|---|---|---|
| | Acres Created/Protected | | | | Acres Lost | | | Net Acres |
| Project Year | Aquatic Acres | Wetland Acres | Bottomland Hardwood Acres | Total Acres Created | Aquatic Acres | Wetland Acres | Total Acres Lost | |
| 1 | 0.7 | 1.7 | 0.0 | 2.4 | -0.7 | -1.7 | -2.4 | 0.0 |
| 2 | 1.4 | 3.5 | 1.2 | 6.1 | -1.4 | -3.5 | -4.9 | 1.2 |
| 3 | 2.1 | 5.2 | 2.4 | 9.7 | -2.1 | -5.2 | -7.3 | 2.4 |
| 4 | 2.8 | 6.9 | 3.6 | 13.3 | -2.8 | -6.9 | -9.7 | 3.6 |
| 5 | 3.5 | 8.7 | 4.8 | 17.0 | -3.5 | -8.7 | -12.2 | 4.8 |
| 6 | 4.2 | 10.4 | 6.0 | 20.6 | -4.2 | -10.4 | -14.6 | 6.0 |
| 7 | 4.9 | 12.1 | 7.2 | 24.2 | -4.9 | -12.1 | -17.0 | 7.2 |
| 8 | 5.6 | 13.9 | 8.4 | 27.9 | -5.6 | -13.9 | -19.5 | 8.4 |
| 9 | 6.3 | 15.6 | 9.6 | 31.5 | -6.3 | -15.6 | -21.9 | 9.6 |
| 10 | 7.0 | 17.4 | 10.8 | 35.2 | -7.0 | -17.4 | -24.4 | 10.8 |
| 11 | 7.7 | 19.1 | 12.0 | 38.8 | -7.7 | -19.1 | -26.8 | 12.0 |
| 12 | 8.4 | 20.8 | 13.2 | 42.4 | -8.4 | -20.8 | -29.2 | 13.2 |
| 13 | 9.1 | 22.6 | 14.4 | 46.1 | -9.1 | -22.6 | -31.7 | 14.4 |
| 14 | 9.8 | 24.3 | 15.6 | 49.7 | -9.8 | -24.3 | -34.1 | 15.6 |
| 15 | 10.5 | 26.0 | 16.8 | 53.3 | -10.5 | -26.0 | -36.5 | 16.8 |
| 16 | 11.2 | 27.8 | 18.0 | 57.0 | -11.2 | -27.8 | -39.0 | 18.0 |
| 17 | 11.9 | 29.5 | 19.2 | 60.6 | -11.9 | -29.5 | -41.4 | 19.2 |
| 18 | 12.6 | 31.2 | 20.4 | 64.2 | -12.6 | -31.2 | -43.8 | 20.4 |
| 19 | 13.3 | 33.0 | 21.6 | 67.9 | -13.3 | -33.0 | -46.3 | 21.6 |
| 20 | 14.0 | 34.7 | 22.8 | 71.5 | -14.0 | -34.7 | -48.7 | 22.8 |
| 21 | 14.7 | 36.4 | 24.0 | 75.1 | -14.7 | -36.4 | -51.1 | 24.0 |
| 22 | 15.4 | 38.2 | 25.2 | 78.8 | -15.4 | -38.2 | -53.6 | 25.2 |
| 23 | 16.1 | 39.9 | 26.4 | 82.4 | -16.1 | -39.9 | -56.0 | 26.4 |
| 24 | 16.8 | 41.6 | 27.6 | 86.0 | -16.8 | -41.6 | -58.4 | 27.6 |
| 25 | 17.5 | 43.4 | 28.8 | 89.7 | -17.5 | -43.4 | -60.9 | 28.8 |
| 26 | 18.2 | 45.1 | 30.0 | 93.3 | -18.2 | -45.1 | -63.3 | 30.0 |
| 27 | 18.9 | 46.8 | 31.2 | 96.9 | -18.9 | -46.8 | -65.7 | 31.2 |
| 28 | 19.6 | 48.6 | 32.4 | 100.6 | -19.6 | -48.6 | -68.2 | 32.4 |
| 29 | 20.3 | 50.3 | 33.6 | 104.2 | -20.3 | -50.3 | -70.6 | 33.6 |
| 30 | 21.0 | 52.1 | 34.8 | 107.9 | -21.0 | -52.1 | -73.1 | 34.8 |
| 31 | 21.7 | 53.8 | 36.0 | 111.5 | -21.7 | -53.8 | -75.5 | 36.0 |
| 32 | 22.4 | 55.5 | 37.2 | 115.1 | -22.4 | -55.5 | -77.9 | 37.2 |
| 33 | 23.1 | 57.3 | 38.4 | 118.8 | -23.1 | -57.3 | -80.4 | 38.4 |
| 34 | 23.8 | 59.0 | 39.6 | 122.4 | -23.8 | -59.0 | -82.8 | 39.6 |
| 35 | 24.5 | 60.7 | 40.8 | 126.0 | -24.5 | -60.7 | -85.2 | 40.8 |
| 36 | 25.2 | 62.5 | 42.0 | 129.7 | -25.2 | -62.5 | -87.7 | 42.0 |
| 37 | 25.9 | 64.2 | 43.2 | 133.3 | -25.9 | -64.2 | -90.1 | 43.2 |
| 38 | 26.6 | 65.9 | 44.4 | 136.9 | -26.6 | -65.9 | -92.5 | 44.4 |
| 39 | 27.3 | 67.7 | 45.6 | 140.6 | -27.3 | -67.7 | -95.0 | 45.6 |
| 40 | 28.0 | 69.4 | 46.8 | 144.2 | -28.0 | -69.4 | -97.4 | 46.8 |
| 41 | 28.7 | 71.1 | 48.0 | 147.8 | -28.7 | -71.1 | -99.8 | 48.0 |
| 42 | 29.4 | 72.9 | 49.2 | 151.5 | -29.4 | -72.9 | -102.3 | 49.2 |
| 43 | 30.1 | 74.6 | 50.4 | 155.1 | -30.1 | -74.6 | -104.7 | 50.4 |
| 44 | 30.8 | 76.3 | 51.6 | 158.7 | -30.8 | -76.3 | -107.1 | 51.6 |
| 45 | 31.5 | 78.1 | 52.8 | 162.4 | -31.5 | -78.1 | -109.6 | 52.8 |
| 46 | 32.2 | 79.8 | 54.0 | 166.0 | -32.2 | -79.8 | -112.0 | 54.0 |
| 47 | 32.9 | 81.5 | 55.2 | 169.6 | -32.9 | -81.5 | -114.4 | 55.2 |
| 48 | 33.6 | 83.3 | 56.4 | 173.3 | -33.6 | -83.3 | -116.9 | 56.4 |
| 49 | 34.3 | 85.0 | 57.6 | 176.9 | -34.3 | -85.0 | -119.3 | 57.6 |
| 50 | 35.0 | 86.8 | 60.0 | 181.8 | -35.0 | -86.8 | -121.8 | 60.0 |
| Cumulative Total | 892.5 | 2,212.1 | 1,471.2 | 4,575.8 | -892.5 | -2,212.1 | -3,104.6 | 1,471.2 |
| Average Annual | 17.9 | 44.2 | 29.424 | 91.5 | -17.9 | -44.2 | -62.1 | 29.4 |

Source: GEC, Inc.

floodwaters, the sediment within the waters will drop north of Hovey Lake instead of being deposited directly into the lake and surrounding wetlands. This will also aid in decreasing erosion and scouring of agricultural fields between the river and Hovey Lake, which will further reduce the amount of sediment entering into the lake during flood events. Reduction of the sediments entering the lake will extend the life of the Hovey Lake aquatic ecosystem and improve the water quality of the lake. Each of these factors will ensure that Hovey Lake will continue to provide quality foraging and overwintering habitat for larvae, juvenile, and adult paddlefish. Reduction of sediment will also help preserve the valuable shallow wetlands surrounding Hovey Lake that are utilized by a variety of terrestrial and aquatic wildlife species.

Beside providing protection from the floodwaters, the reforestation project will provide quality bottomland hardwood forest habitat for a variety of terrestrial species, including neotropical migrant birds dependent on woodlands and mast-producing species for reproduction, foraging, and cover. The additional acreage of bottomland hardwood forest would further enhance and diversify the already unique Hovey Lake ecosystem.

Alternative 3 consists of reforestation of 120 acres of agricultural lands with bottomland hardwoods. If Alternative 3 is implemented alone (without implementing Alternative 2, Shoreline Stabilization), it is assumed that the riverbank will continue to erode to the point that by the end of the project life the river will claim 50 percent (60 acres) of the proposed 120 reforested acres. Therefore, Alternative 3 will initially result in the creation of 120 acres of bottomland hardwoods habitat, decreasing on a constant basis to 60 acres by Year 50 of the project. On an average annual basis, this will result in creation of 90.6 acres. Table 3-7 presents the acres of habitat created by Alternative 3, habitat lost if no action is taken, and the net impact of the alternative for each year of the project. The average annual impacts of the alternative are also presented. Creation of the 120 acres of bottomland hardwood habitat would also prevent the loss of wetlands and aquatic habitat. The loss of bottomland hardwood habitat acreage over the life of the project if Alternative 3 is implemented without shoreline stabilization will result in a corresponding reduction in acres of wetlands and aquatic habitat protected. Wetland habitat protected by Alternative 3 will equate to an average annual 132.7 acres, and aquatic habitat protected will equate to an average annual 53.6 acres.

If Alternative 3 is not implemented (no-action), sediment from Ohio River flood events will continue to be deposited in Hovey Lake and the surrounding wetlands. This would result in a corresponding loss of 5.2 acres of wetland habitat at the beginning of the project, increasing to 260 acres at the end of the project, for an average annual loss of 132.7 acres. There would also be a loss of 2.1 acres of aquatic habitat at the beginning of the project, increasing to 105 acres by the end of the project, for an average annual loss of 53.6 acres. No-action under this alternative will result in the loss of a total of 186.3 acres on an average annual basis. In summary, the net benefits of Alternative 3 are the creation or protection of 90.6 average annual acres of habitat, calculated as the acres created/protected by this alternative (276.9 acres), adjusted for acres lost under no-action (186.3 acres).

### 3.4.3 Summary of Environmental Benefits

Table 3-8 presents a summary of annual environmental outputs for each alternative as stand-alone aspects of the project. For each alternative, the acres lost if no action is taken and the net acres gained if the alternative is implemented are presented. Under Alternative 1, Restoration of Oxbow

## Table 3-7. Annual Benefits Associated With Alternative 3, Restoration, Hovey Lake Restoration Project

| | Action | | | | No-Action | | | Total |
|---|---|---|---|---|---|---|---|---|
| | Acres Created/Protected | | | | Acres Lost | | | Net Acres |
| Project Year | Aquatic Acres | Wetland Acres | Bottomland Hardwood Acres | Total Acres Created | Aquatic Acres | Wetland Acres | Total Acres Lost | |
| 1 | 2.1 | 5.2 | 120.0 | 127.3 | -2.1 | -5.2 | -7.3 | 120.0 |
| 2 | 4.2 | 10.4 | 118.8 | 133.4 | -4.2 | -10.4 | -14.6 | 118.8 |
| 3 | 6.3 | 15.6 | 117.6 | 139.5 | -6.3 | -15.6 | -21.9 | 117.6 |
| 4 | 8.4 | 20.8 | 116.4 | 145.6 | -8.4 | -20.8 | -29.2 | 116.4 |
| 5 | 10.5 | 26.0 | 115.2 | 151.7 | -10.5 | -26.0 | -36.5 | 115.2 |
| 6 | 12.6 | 31.2 | 114.0 | 157.8 | -12.6 | -31.2 | -43.8 | 114.0 |
| 7 | 14.7 | 36.4 | 112.8 | 163.9 | -14.7 | -36.4 | -51.1 | 112.8 |
| 8 | 16.8 | 41.6 | 111.6 | 170.0 | -16.8 | -41.6 | -58.4 | 111.6 |
| 9 | 18.9 | 46.8 | 110.4 | 176.1 | -18.9 | -46.8 | -65.7 | 110.4 |
| 10 | 21.0 | 52.1 | 109.2 | 182.3 | -21.0 | -52.1 | -73.1 | 109.2 |
| 11 | 23.1 | 57.3 | 108.0 | 188.4 | -23.1 | -57.3 | -80.4 | 108.0 |
| 12 | 25.2 | 62.5 | 106.8 | 194.5 | -25.2 | -62.5 | -87.7 | 106.8 |
| 13 | 27.3 | 67.7 | 105.6 | 200.6 | -27.3 | -67.7 | -95.0 | 105.6 |
| 14 | 29.4 | 72.9 | 104.4 | 206.7 | -29.4 | -72.9 | -102.3 | 104.4 |
| 15 | 31.5 | 78.1 | 103.2 | 212.8 | -31.5 | -78.1 | -109.6 | 103.2 |
| 16 | 33.6 | 83.3 | 102.0 | 218.9 | -33.6 | -83.3 | -116.9 | 102.0 |
| 17 | 35.7 | 88.5 | 100.8 | 225.0 | -35.7 | -88.5 | -124.2 | 100.8 |
| 18 | 37.8 | 93.7 | 99.6 | 231.1 | -37.8 | -93.7 | -131.5 | 99.6 |
| 19 | 39.9 | 98.9 | 98.4 | 237.2 | -39.9 | -98.9 | -138.8 | 98.4 |
| 20 | 42.0 | 104.1 | 97.2 | 243.3 | -42.0 | -104.1 | -146.1 | 97.2 |
| 21 | 44.1 | 109.3 | 96.0 | 249.4 | -44.1 | -109.3 | -153.4 | 96.0 |
| 22 | 46.2 | 114.5 | 94.8 | 255.5 | -46.2 | -114.5 | -160.7 | 94.8 |
| 23 | 48.3 | 119.7 | 93.6 | 261.6 | -48.3 | -119.7 | -168.0 | 93.6 |
| 24 | 50.4 | 124.9 | 92.4 | 267.7 | -50.4 | -124.9 | -175.3 | 92.4 |
| 25 | 52.5 | 130.1 | 91.2 | 273.8 | -52.5 | -130.1 | -182.6 | 91.2 |
| 26 | 54.6 | 135.3 | 90.0 | 279.9 | -54.6 | -135.3 | -189.9 | 90.0 |
| 27 | 56.7 | 140.5 | 88.8 | 286.0 | -56.7 | -140.5 | -197.2 | 88.8 |
| 28 | 58.8 | 145.7 | 87.6 | 292.1 | -58.8 | -145.7 | -204.5 | 87.6 |
| 29 | 60.9 | 150.9 | 86.4 | 298.2 | -60.9 | -150.9 | -211.8 | 86.4 |
| 30 | 63.0 | 156.2 | 85.2 | 304.4 | -63.0 | -156.2 | -219.2 | 85.2 |
| 31 | 65.1 | 161.4 | 84.0 | 310.5 | -65.1 | -161.4 | -226.5 | 84.0 |
| 32 | 67.2 | 166.6 | 82.8 | 316.6 | -67.2 | -166.6 | -233.8 | 82.8 |
| 33 | 69.3 | 171.8 | 81.6 | 322.7 | -69.3 | -171.8 | -241.1 | 81.6 |
| 34 | 71.4 | 177.0 | 80.4 | 328.8 | -71.4 | -177.0 | -248.4 | 80.4 |
| 35 | 73.5 | 182.2 | 79.2 | 334.9 | -73.5 | -182.2 | -255.7 | 79.2 |
| 36 | 75.6 | 187.4 | 78.0 | 341.0 | -75.6 | -187.4 | -263.0 | 78.0 |
| 37 | 77.7 | 192.6 | 76.8 | 347.1 | -77.7 | -192.6 | -270.3 | 76.8 |
| 38 | 79.8 | 197.8 | 75.6 | 353.2 | -79.8 | -197.8 | -277.6 | 75.6 |
| 39 | 81.9 | 203.0 | 74.4 | 359.3 | -81.9 | -203.0 | -284.9 | 74.4 |
| 40 | 84.0 | 208.2 | 73.2 | 365.4 | -84.0 | -208.2 | -292.2 | 73.2 |
| 41 | 86.1 | 213.4 | 72.0 | 371.5 | -86.1 | -213.4 | -299.5 | 72.0 |
| 42 | 88.2 | 218.6 | 70.8 | 377.6 | -88.2 | -218.6 | -306.8 | 70.8 |
| 43 | 90.3 | 223.8 | 69.6 | 383.7 | -90.3 | -223.8 | -314.1 | 69.6 |
| 44 | 92.4 | 229.0 | 68.4 | 389.8 | -92.4 | -229.0 | -321.4 | 68.4 |
| 45 | 94.5 | 234.2 | 67.2 | 395.9 | -94.5 | -234.2 | -328.7 | 67.2 |
| 46 | 96.6 | 239.4 | 66.0 | 402.0 | -96.6 | -239.4 | -336.0 | 66.0 |
| 47 | 98.7 | 244.6 | 64.8 | 408.1 | -98.7 | -244.6 | -343.3 | 64.8 |
| 48 | 100.8 | 249.8 | 63.6 | 414.2 | -100.8 | -249.8 | -350.6 | 63.6 |
| 49 | 102.9 | 255.0 | 62.4 | 420.3 | -102.9 | -255.0 | -357.9 | 62.4 |
| 50 | 105.0 | 260.3 | 60.0 | 425.3 | -105.0 | -260.3 | -365.3 | 60.0 |
| Cumulative Total | 2,677.5 | 6,636.4 | 4,528.8 | 13,842.7 | -2,677.5 | -6,636.4 | -9,313.9 | 4,528.8 |
| Average Annual | 53.6 | 132.7 | 90.6 | 276.9 | -53.6 | -132.7 | -186.3 | 90.6 |

Source: GEC, Inc.

## Table 3-8. Summary of Net Annual Benefits for the Various Alternatives, Hovey Lake Restoration Project

| | Alternative 1 | | Alternative 2 | | Alternative 3 | | All Alternatives | |
|---|---|---|---|---|---|---|---|---|
| | No-Action | Action | No-Action | Action | No-Action | Action | No-Action | Action |
| Year | | Net Acres | | Net Acres | | Net Acres | Total Acres | Net Acres |
| 1 | 0 | 145.0 | -2.4 | 0.0 | -7.3 | 120.0 | -9.7 | 265.0 |
| 2 | 0 | 145.0 | -4.9 | 1.2 | -14.6 | 118.8 | -19.5 | 265.0 |
| 3 | 0 | 145.0 | -7.3 | 2.4 | -21.9 | 117.6 | -29.2 | 265.0 |
| 4 | 0 | 145.0 | -9.7 | 3.6 | -29.2 | 116.4 | -39.0 | 265.0 |
| 5 | 0 | 145.0 | -12.2 | 4.8 | -36.5 | 115.2 | -48.7 | 265.0 |
| 6 | 0 | 145.0 | -14.6 | 6.0 | -43.8 | 114.0 | -58.4 | 265.0 |
| 7 | 0 | 145.0 | -17.0 | 7.2 | -51.1 | 112.8 | -68.2 | 265.0 |
| 8 | 0 | 145.0 | -19.5 | 8.4 | -58.4 | 111.6 | -77.9 | 265.0 |
| 9 | 0 | 145.0 | -21.9 | 9.6 | -65.7 | 110.4 | -87.7 | 265.0 |
| 10 | 0 | 145.0 | -24.4 | 10.8 | -73.1 | 109.2 | -97.4 | 265.0 |
| 11 | 0 | 145.0 | -26.8 | 12.0 | -80.4 | 108.0 | -107.1 | 265.0 |
| 12 | 0 | 145.0 | -29.2 | 13.2 | -87.7 | 106.8 | -116.9 | 265.0 |
| 13 | 0 | 145.0 | -31.7 | 14.4 | -95.0 | 105.6 | -126.6 | 265.0 |
| 14 | 0 | 145.0 | -34.1 | 15.6 | -102.3 | 104.4 | -136.4 | 265.0 |
| 15 | 0 | 145.0 | -36.5 | 16.8 | -109.6 | 103.2 | -146.1 | 265.0 |
| 16 | 0 | 145.0 | -39.0 | 18.0 | -116.9 | 102.0 | -155.8 | 265.0 |
| 17 | 0 | 145.0 | -41.4 | 19.2 | -124.2 | 100.8 | -165.6 | 265.0 |
| 18 | 0 | 145.0 | -43.8 | 20.4 | -131.5 | 99.6 | -175.3 | 265.0 |
| 19 | 0 | 145.0 | -46.3 | 21.6 | -138.8 | 98.4 | -185.1 | 265.0 |
| 20 | 0 | 145.0 | -48.7 | 22.8 | -146.1 | 97.2 | -194.8 | 265.0 |
| 21 | 0 | 145.0 | -51.1 | 24.0 | -153.4 | 96.0 | -204.5 | 265.0 |
| 22 | 0 | 145.0 | -53.6 | 25.2 | -160.7 | 94.8 | -214.3 | 265.0 |
| 23 | 0 | 145.0 | -56.0 | 26.4 | -168.0 | 93.6 | -224.0 | 265.0 |
| 24 | 0 | 145.0 | -58.4 | 27.6 | -175.3 | 92.4 | -233.8 | 265.0 |
| 25 | 0 | 145.0 | -60.9 | 28.8 | -182.6 | 91.2 | -243.5 | 265.0 |
| 26 | 0 | 145.0 | -63.3 | 30.0 | -189.9 | 90.0 | -253.2 | 265.0 |
| 27 | 0 | 145.0 | -65.7 | 31.2 | -197.2 | 88.8 | -263.0 | 265.0 |
| 28 | 0 | 145.0 | -68.2 | 32.4 | -204.5 | 87.6 | -272.7 | 265.0 |
| 29 | 0 | 145.0 | -70.6 | 33.6 | -211.8 | 86.4 | -282.5 | 265.0 |
| 30 | 0 | 145.0 | -73.1 | 34.8 | -219.2 | 85.2 | -292.2 | 265.0 |
| 31 | 0 | 145.0 | -75.5 | 36.0 | -226.5 | 84.0 | -301.9 | 265.0 |
| 32 | 0 | 145.0 | -77.9 | 37.2 | -233.8 | 82.8 | -311.7 | 265.0 |
| 33 | 0 | 145.0 | -80.4 | 38.4 | -241.1 | 81.6 | -321.4 | 265.0 |
| 34 | 0 | 145.0 | -82.8 | 39.6 | -248.4 | 80.4 | -331.2 | 265.0 |
| 35 | 0 | 145.0 | -85.2 | 40.8 | -255.7 | 79.2 | -340.9 | 265.0 |
| 36 | 0 | 145.0 | -87.7 | 42.0 | -263.0 | 78.0 | -350.6 | 265.0 |
| 37 | 0 | 145.0 | -90.1 | 43.2 | -270.3 | 76.8 | -360.4 | 265.0 |
| 38 | 0 | 145.0 | -92.5 | 44.4 | -277.6 | 75.6 | -370.1 | 265.0 |
| 39 | 0 | 145.0 | -95.0 | 45.6 | -284.9 | 74.4 | -379.9 | 265.0 |
| 40 | 0 | 145.0 | -97.4 | 46.8 | -292.2 | 73.2 | -389.6 | 265.0 |
| 41 | 0 | 145.0 | -99.8 | 48.0 | -299.5 | 72.0 | -399.3 | 265.0 |
| 42 | 0 | 145.0 | -102.3 | 49.2 | -306.8 | 70.8 | -409.1 | 265.0 |
| 43 | 0 | 145.0 | -104.7 | 50.4 | -314.1 | 69.6 | -418.8 | 265.0 |
| 44 | 0 | 145.0 | -107.1 | 51.6 | -321.4 | 68.4 | -428.6 | 265.0 |
| 45 | 0 | 145.0 | -109.6 | 52.8 | -328.7 | 67.2 | -438.3 | 265.0 |
| 46 | 0 | 145.0 | -112.0 | 54.0 | -336.0 | 66.0 | -448.0 | 265.0 |
| 47 | 0 | 145.0 | -114.4 | 55.2 | -343.3 | 64.8 | -457.8 | 265.0 |
| 48 | 0 | 145.0 | -116.9 | 56.4 | -350.6 | 63.6 | -467.5 | 265.0 |
| 49 | 0 | 145.0 | -119.3 | 57.6 | -357.9 | 62.4 | -477.3 | 265.0 |
| 50 | 0 | 145.0 | -121.8 | 60.0 | -365.3 | 60.0 | -487.0 | 265.0 |
| Cumulative Total | 0 | 7,250.0 | -3104.6 | 1,471.2 | -9313.9 | 4,528.8 | -12,418.5 | 13,250.0 |
| Average Annual | 0 | 145.0 | -62.1 | 29.4 | -186.3 | 90.6 | -248.4 | 265.0 |

Source: GEC, Inc.

Habitat, no-action results in no significant impacts, while implementing the alternative results in average annual net impacts of 145 acres. For Alternative 2, Shoreline Stabilization, which is dependent on the implementation of Alternative 3, Reforestation, no-action results in an average annual loss of 62.1 acres, while implementing the alternative results in average annual net impacts of 29.4 acres. Under Alternative 3, Reforestation, no-action results in an average annual loss of 186.3 acres, while implementing the alternative results in average annual net impacts of 90.6 acres. No-action for all three alternatives results in the average annual loss of a total of 248.4 acres of habitat.

## 3.5 Relationship Among Alternatives

All three alternatives can be effectively combined in various combinations, except that Alternative 2, Shoreline Stabilization, is dependent on Alternative 3, Reforestation. Without Alternative 3, Alternative 2 will not result in any significant impacts. The costs and environmental outputs of the alternatives when combined are additive. IWR-PLAN requires that each alternative be assigned costs and outputs associated with implementing and not implementing the alternative. The cost for not implementing an alternative (no-action) is $0. The environmental outputs associated with not implementing an alternative (no-action) are the quantity of habitat that would be lost over the life of the project if the alternative is not implemented. These values are calculated in terms of average annual impacts, which are the cumulative number of acres impacted each year by the project divided by 50, the number of years the project will exist. The no-action outputs are entered into IWR-PLAN as negative values (lost habitat).

The cost of implementing each alternative is stated in average annual costs and includes construction costs and operation and maintenance costs. The environmental outputs associated with implementing each alternative are calculated as the quantity of habitat created by the alternative and the quantity of habitat protected from loss if the alternative were not implemented (the no-action negative impacts). Because of the method that IWR-PLAN uses to combine alternatives to derive the various combinations of alternatives, the impacts associated with implementing the alternative must be entered into the program as net impacts. Net impacts for each alternative are calculated as the impacts associated with implementing the alternative minus the no-action impacts.

When developing the combination of alternatives, IWR-PLAN includes each alternative in the combination and assigns either an action or no-action status to each. As a result, an alternative that by itself has positive impacts could be combined with the no-action of the other alternatives and result in an overall negative impact for the combination of alternatives. For instance, the IWR-PLAN derived output from implementing Alternative 1 is actually calculated as the combination of the net impacts of the action of Alternative 1 (145 acres) and the no-action impacts of Alternative 2 (-62.1 acres) and Alternative 3 (-186.3 acres), resulting in a combined impact of -103.4 acres. Similarly, the output of the combination of alternatives 1, 2, and 3 is derived by combining the net impacts of the action of alternatives 1, 2, and 3.

Including no-action, a total of six actual combinations of alternatives exist. The net impacts for each of the combinations are presented in Table 3-9.

**Table 3-9. Summary of Net Annual Benefits for Each Combination of Alternatives, Hovey Lake Restoration Project**

| Combinations of | Alternative 1 | | Alternative 2 | | Alternative 3 | | |
|---|---|---|---|---|---|---|---|
| Alternatives | Action | No-Action | Action | No-Action | Action | No-Action | Total |
| No-Action | - | 0.0 | - | 0.0 | - | 0.0 | 0.0 |
| Alternative 1 | 145.0 | - | - | -62.1 | - | -186.3 | -103.4 |
| Alternative 2 | - | - | - | - | - | - | - |
| Alternative 3 | - | 0.0 | - | -62.1 | 90.6 | - | 28.5 |
| Alternatives 1 & 3 | 145.0 | - | - | -62.1 | 90.6 | - | 173.5 |
| Alternatives 2 & 3 | - | 0.0 | 29.4 | - | 90.6 | - | 120.0 |
| Alternatives 1, 2 & 3 | 145.0 | - | 29.4 | - | 90.6 | - | 265.0 |

NOTE: Since Alternative 2 is dependent on Alternative 3, there are no benefits listed for the stand alone Alternative 2 combination.
Source: GEC, Inc.

## 3.6 Cost Effectiveness Analysis

As stated earlier, cost effectiveness analysis is intended to illustrate which alternatives can produce the same amount of environmental output for less costs or a larger quantity of output for the same or less cost. Table 3-10 presents the average annual cost, annual environmental outputs, and average cost per output for each combination of alternatives. The cost-effective combinations are: no-action; Alternative 3; and the combinations of alternatives 2 and 3, alternatives 1 and 3, and alternatives 1, 2, and 3. These combinations are presented in bold type in Table 3-10.

**Table 3-10. Hovey Lake Restoration Project, Cost Effectiveness Analysis**

| Alternative | Outputs (Acres) | Costs ($1,000) | Average Cost ($/Acres) |
|---|---|---|---|
| **No Action** | **-248.4** | **0.0** | **0** |
| Alternative 1 | -103.4 | 283.0 | -2,736 |
| Alternative 2 | 0.0 | 34.8 | N/A |
| **Alternative 3** | **28.5** | **24.7** | **86.6** |
| **Alternatives 1 and 3** | **173.5** | **307.7** | **1,773** |
| **Alternatives 2 and 3** | **120.0** | **59.5** | **495** |
| **Alternatives 1, 2 and 3** | **265.0** | **342.5** | **1,292** |

Source: G.E.C., Inc.

## 3.7 Incremental Cost Analysis

Incremental cost analysis illustrates the increase in costs associated with advancing from one output level to the next higher output level. Table 3-11 presents the average annual cost, the annual environmental output, the average cost of output, the incremental output, and the total and per unit incremental cost of the cost-effective alternatives.

The average cost per habitat acre for the combination of alternatives 2 and 3 is $495, which is also the incremental cost per acre. A total of 120 beneficial habitat acres are produced under this

**Table 3-11. Hovey Lake Restoration Project, Incremental Cost Analysis of Increasing Output from the No-Action Alternative of the "Best Buy" Alternatives**

| Alternative | Outputs (Acres) | Costs ($1,000) | Average Cost ($/Acres) | Incremental Cost ($1,000) | Incremental Output (Acres) | Incremental Cost Per Output ($) |
|---|---|---|---|---|---|---|
| Alternatives 2 and 3 | 120.0 | 59.50 | 495 | 59.5 | 120.0 | 495 |
| Alternatives 1, 2 and 3 | 265.0 | 342.50 | 1,292 | 283.0 | 145.0 | 1,951 |

Source: G.E.C., Inc.

combination. The total annual incremental cost, the increase in costs from no-action, is $59,500. The combination of alternatives 1, 2, and 3 produces 265 beneficial habitat acres at an annual average cost of $342,500, resulting in an average cost of $1,292 per habitat acre. When compared to the combination of alternatives 2 and 3, the annual incremental cost of this combination is $283,000, and the incremental output is 145 beneficial habitat acres, yielding a per unit incremental cost of $1,951.

## 4.0 SUMMARY AND CONCLUSION

This report presents an incremental analysis of the Hovey Lake Restoration Project, which is associated with a proposed ecosystem restoration program for the Ohio River. The proposed Hovey Lake Restoration Project area is located at the State of Indiana's Hovey Lake FWA, one of a few large Ohio River oxbow lakes remaining in the state. Oxbow lakes, which are cut off from the river except during periods of high river stage, are important spawning, nursery and feeding areas for fishes and provide important habitat for migratory waterfowl, wading birds and other wildlife. Oxbow lakes, due to their cut-off nature and location within floodplains, slowly fill in with sediments. The specific goals of the Hovey Lake Restoration Project include two distinct elements designed to prolong the functional life of the aquatic ecosystem at Hovey Lake and to improve the fish and wildlife habitat within the project area. Three alternatives were evaluated as part of the Restoration Project and include: Alternative 1, Restoration of Oxbow Habitat; Alternative 2, Shoreline Stabilization; and Alternative 3, Reforestation.

Under Alternative 1, Restoration of Oxbow Habitat, approximately 145 acres of the 300-acre open basin of Hovey Lake would be dredged from the current depth of six to seven feet to a proposed depth ranging from 7 to 20 feet. This alternative should prolong the life of the lake and create deep-water habitat. Under Alternative 2, Shoreline Stabilization, 0.9 mile of the Ohio River north of Hovey Lake will be stabilized using A-jacks structures or other similar structures. By reducing riverbank erosion, this alternative should prevent the river from eroding the areas to be reforested north of Hovey Lake and reduce sediment depositions in Hovey Lake and the surrounding wetlands. Under Alternative 3, Reforestation, 120 acres of floodplain north of Hovey Lake will be reforested. This alternative will aid in the reduction of drift trash and sediment from Ohio River floodwaters from settling in Hovey Lake and the surrounding wetlands.

The following subsections provide a summary of impacts, as well as the cost effectiveness analysis.

## 4.1 Environmental Benefits

**4.1.1. Alternative 1. Restoration of Oxbow Habitat.** Dredging the open basin of Hovey Lake will help prolong the life of the lake aquatic ecosystem that provides quality habitat for a variety of fishes, benthic organisms, birds, reptiles, amphibians, and mammals. If this alternative is implemented, 145 acres of aquatic habitat will be created at the beginning of the project by increasing the volume of the lake by about 1,550 acre-feet of water. There will be no direct loss of habitat for no-action under this alternative. Therefore, the average annual net impact of this alternative alone will be the creation of 145 acres of beneficial habitat.

**4.1.2. Erosion/Sediment Control and Ohio River Bank Stabilization.** The purpose of alternatives 2 and 3 is to reduce sediment deposition in Hovey Lake and surrounding wetlands during Ohio River flood events. Floodwater sediments originate from floodplain scour of the farmed areas north of the lake, riverborne sediments, and heavy bank erosion along the Ohio River banks north of the lake. These alternatives include stabilizing the shoreline of 0.9 miles of the Ohio River bank north of Hovey Lake and reforestation of 120 acres adjacent to the Ohio River.

These alternatives will prevent approximately five feet of sediment from settling over the 300-acre open basin of the lake, protecting a total volume of 1,500 acre-feet of water over the 50-year life of the project, or an average of 750 acre-feet a year. These alternatives protect only half the volume of aquatic habitat as Alternative 1. Therefore, the beneficial habitat acreage protected by these alternatives on a comparable basis to Alternative 1 is 72.5 acres of aquatic habitat. Without these alternatives, sediment from Ohio River flood events will continue to be dropped in wetlands surrounding the lake, eventually destroying the wetlands. These alternatives would prevent most of this sediment from settling in the lake and wetlands and thereby extend the life of the wetlands.

**4.1.2.1. Alternative 2. Shoreline Stabilization.** Stabilizing the 0.9 mile of the Ohio River bank north of Hovey Lake would prevent the erosion of the land north of the lake. Without shoreline stabilization, eventually 50 percent of the proposed 120-acre reforested area would erode into the river by the end of the project life.

Implementing Alternative 2 will prevent these acres from being lost to erosion. The environmental benefits of this alternative include protection of 29.4 acres of bottomland hardwood habitat on an average annual basis. Protecting the bottomland hardwoods from loss by erosion also results in a corresponding protection of wetland and aquatic habitat acreage. Alternative 2 will protect 44.2 acres of wetland habitat and 17.9 acres of aquatic habitat on an average annual basis. In total, this alternative results in the protection of 91.5 acres on an average annual basis. However, these benefits will only be realized if Alternative 2 is implemented in conjunction with Alternative 3, Reforestation. Shoreline stabilization, if implemented alone, will not have a significant impact on improving the Hovey Lake ecosystem.

If Alternative 2 is not implemented (no-action), the Ohio River will continue to erode the river banks, and a portion of the 120 acres of the proposed reforested lands north of the lake will be lost to the river. The loss of these bottomland hardwoods will result in the corresponding average annual loss of 44.2 acres of wetland habitat and 17.9 acres of aquatic habitat, for a total of 62.1 acres on an average annual basis.

In summary, the net benefits of Alternative 2 are the protection of 29.4 average annual acres of habitat, calculated as the acres protected by this alternative (91.5 acres) adjusted for acres loss under no-action (62.1 acres).

**4.1.2.1 Alternative 3. Reforestation.** The reforestation of 120 acres of floodplain north of Hovey Lake will reduce drift, trash and sediment from Ohio River flood events from being deposited in Hovey Lake and the surrounding wetlands. If Alternative 3 is implemented alone (without implementing Alternative 2, Shoreline Stabilization), it is assumed that the riverbank will continue to erode to the point that by the end of the project life the river will claim 50 percent (60 acres) of the proposed 120 reforested acres. Therefore, Alternative 3 will result in the creation of 90.6 acres on an average annual basis. Creation of the bottomland hardwood habitat would also protect 347 acres of wetlands and 72.5 acres of aquatic habitat. The loss of bottomland hardwood habitat acreage over the life of the project if Alternative 3 is implemented without shoreline stabilization will result in a corresponding reduction in acres of wetlands and aquatic habitat protected. Alternative 3 will prevent the loss of 132.7 acres of wetlands and 53.6 aquatic acres on an average annual basis.

If Alternative 3 is not implemented (no-action), sediment from Ohio River flood events will continue to be deposited in Hovey Lake and the surrounding wetlands. This would result in an average annual loss of 132.7 acres of wetland habitat and 53.6 acres of aquatic habitat, for a total of 186.3 acres. In summary, the net benefits of Alternative 3 are the creation or protection of 90.6 average annual acres of habitat, calculated as the acres created/protected by this alternative (276.9 acres), adjusted for acres lost under no-action (186.3 acres).

## 4.2 Cost Effectiveness and Incremental Cost Analysis

Cost effectiveness and incremental cost analyses were conducted for the combination of alternatives in order to provide decision-makers with information to choose the combination of alternatives that best satisfy project objectives. The environmental output of alternatives 1, 2 and 3 were measured in habitat acres. Cost effectiveness analysis compares alternative plans that produce environmental outputs and determines which plan produces the largest quantity of output for a given cost, or produces the same or greater quantity of output for less cost. The cost-effective alternatives and combination of alternatives are: no-action; Alternative 3; and the combinations of alternatives 2 and 3, alternatives 1 and 3, and alternatives 1, 2, and 3.

Incremental cost analysis compares the increase in costs (of cost-effective alternatives) of advancing from one output level to the next higher level of output. The average cost per habitat acre for the combination of alternatives 2 and 3 is $495, which is also the incremental cost per acre. A total of 120 beneficial habitat acres are produced under this combination. The total annual incremental cost, the increase in costs from no-action, is $59,500. The combination of alternatives 1, 2, and 3 produces 265 beneficial habitat acres, at an average cost of $1,292 per habitat acre. When compared to the combination of alternatives 2 and 3, the annual incremental cost of this combination is $283,000, and the incremental output is 145 beneficial habitat acres, yielding a per unit incremental cost of $1,951.